# AMERICAN MACHINIST

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## A New Drawing Table.

With this we give an illustration of a neat drawing table which is simple in construction and possesses several new features which will add much to the convenience and comfort of the draftsman. The front of the stand is arranged so that the board can be readily adjusted through a vertical range of 6 inches to suit the height of the user, and is then securely held by thumb screws in the cast-iron guide. The board can be tilted from a horizontal position to nearly a vertical one by simply raising its rear edge to any desired angle, and is automatically locked by means of cams engaging with slides, as shown at the back of the stand. The cams, one at each end of the table, are connected by a horizontal rod by which both can be disengaged, and the rear edge of the board lowered from either end of the stand.

The drawing board is made of pine, and is held in a strong oak or ash frame whose length is such as to leave a space between the ends of the frame and board through which the paper can be passed when it is necessary to make a drawing whose length is greater than that of the board, and the corners at the ends of the board are rounded to avoid breaking the paper when such long drawings are to be made. Paper can be fastened to either side of the board.

A deep groove is cut in three edges of the frame for an endless wire carried by sheaves 2 inches diameter in each corner of frame and the groove in frame is deep enough to keep the sheaves and wires within it, so they do not in any way interfere. The ends of a parallel ruler are clamped by means of steel-spring clips, operated by brass knurled nuts. The parallel ruler can be quickly set to any angle, and can be moved with great ease and accuracy across the board. These tables are manufactured in three sizes, for drawings 30″x 42″, 36″x48″ and 36″x60″, by the inventor, Henry J. Hughes, 360 45th street, Brooklyn, N. Y.

A NEW DRAWING TABLE.

## Improved Automatic Gear Cutter.

We illustrate herewith a new form of automatic gear cutter, which has been designed especially for such work as the cutting of the gears used in the motors of street cars—work which is of such a character and is done in such quantities as to demand a machine of very great strength and capacity, and one which is capable of being driven at full capacity continuously without danger of breakdowns or serious wear.

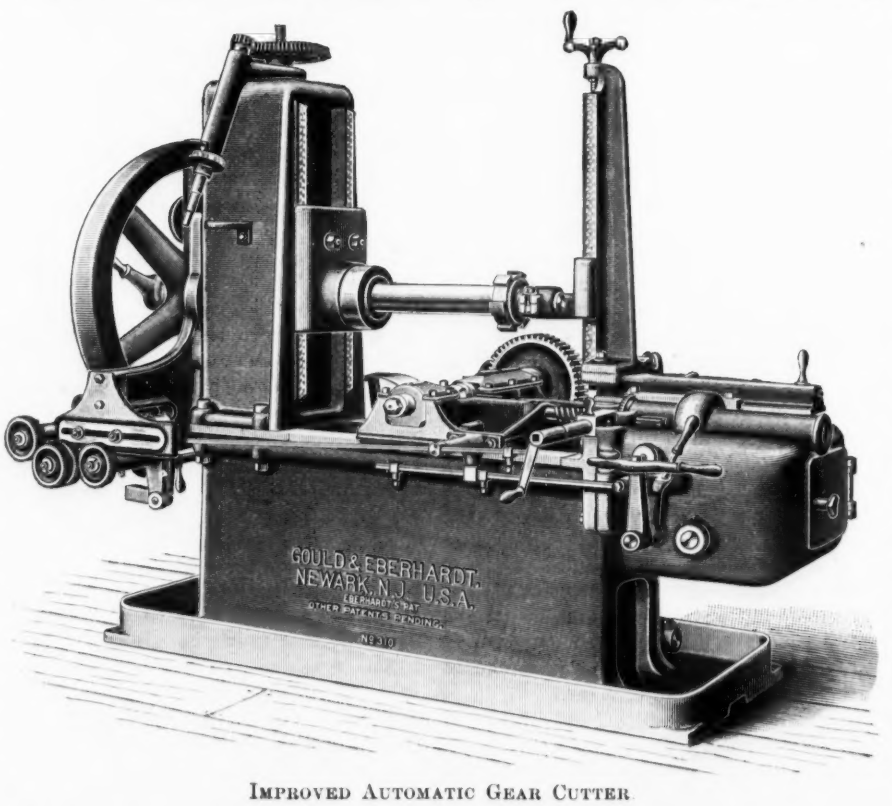
Being used for spur gears only, considerable simplification was possible as compared with machines designed to cut bevel gears also; and, as will be perceived, the machine has been given very substantial proportions.

Only one belt is used upon the machine, and that is the main driving belt which comes down from the countershaft; and it drives a pulley whose position is fixed, thus doing away with the necessity for tighteners, weights, etc., while all the motions of the machine are derived from positive working mechanisms.

It will be noticed that the index wheel is a very substantial one, and is covered by a shield, which protects it from dust or accidental injury. There is a very large work spindle carrying a heavy arbor, which has an outboard support to prevent vibration.

The saddle upon which the cutter spindle is mounted is a long and broad one, and the cutter is directly over the middle of it, thus giving the cutter the best possible support and equalizing the wear of the saddle upon the slide. The feed screw is directly in line with the cutter, and is attached rigidly to the carriage, the nut being revolved upon it by substantial gearing.

The makers state that this machine is easily capable of cutting from two to three times the number of gears per day that could be cut by machines of the older types; which means 12 to 18 motor gears per day. It is built by Gould & Eberhardt, Newark, N. J.




IMPROVED AUTOMATIC GEAR CUTTER.

We have inquiries, in more than abundance, from those who are approached by circulars advising investment in this or that scheme for making lots of money out of small capital. It is scarcely necessary to say more than that the banks of the country have more money than they know what to do with, and 5 per cent. is considered a gilt-edge investment; when 15 or 20 per cent. is offered, our advice is, look sharp after the security. It seems to be natural enough that the man of abundant means shall find opportunities to invest his capital at a big rate of interest, but the mechanic of small means cannot afford to take the chance of modern practice in "scooping in" the fellows who lack means to fight for their rights. As a rule the first-class mechanic is a very indifferent speculator.

## Mechanics of Safe Burglary—II.

BY F. G. H.

A long article appeared recently in a Chicago paper upon the subject of dynamite as used in express robberies, and a labored attempt was made to represent that Mr. C. H. Crosby, V. P. of U. S. Express Co., and others, witnessed experiments that demonstrated, or pretended to demonstrate, rather, that an express car door, made of wood, and covered with ⅛ inch boiler plate on each side, was a dynamite-proof door. A more ridiculous proposition was never submitted for the consideration of an intelligent man.

After this fake demonstration, a so called fire and burglar-proof safe was experimented upon, and 3½ pounds of dynamite was fired in different charges.

The safe is represented as having withstood the test, and the express people are represented as having said:

"We now know that the burglar-proof safes we have on our trains are secure against train robbers for two reasons, first, the robbers cannot open them with small charges of dynamite; second, if they use large charges they will blow the car and every one around to pieces. The safe blown open on the Lake Shore was not burglar-proof; it was only fire-proof. We placed the charges as an expert cracksman would, and tamped them with fire-clay."

The report goes on to state at length how the charges were applied, and they exhibit either a total ignorance of the subject, or else a fixed determination to mislead their spectators. No cracksman who understands his business would ever undertake to burglarize a safe in the manner these gentlemen proceeded, and the parties who witnessed the operation were most woefully deceived, if they formulated any conclusions from the evidence presented.

There seems to be a strong effort on the part of safe men and amateur experts on explosives, to talk continually about dynamite. Now dynamite is never used to open a safe by a scientific burglar.

It is very difficult to insert dynamite, but nitro-glycerine is very easily inserted, is much more powerful than dynamite, and is the explosive used by the modern burglar who knows his business. This fact is established beyond all possibility of doubt by the recent report of the U. S. Treasury Commission on safe and vault-door construction.

The late robbery of the Franklin Grove Bank, in Illinois, see Fig. 1, where a new Hall bank safe (Herring-Hall-Marvin Co.) was opened in a very short time with nitro-glycerine, and without making enough noise to attract attention on the street, is a fair example of the methods of modern burglars, and the sooner the public at large understand the real danger and the details of attack, the sooner something will be invented to head off the burglar.

The Herring-Hall Safe Co. is a very extensive concern, and widely known. They build as substantial a square bank safe, of the most approved material for this type of safe (chrome steel), as can be made, and yet the Franklin Grove safe gave apparently no more resistance than an oak box, nor

will any other built up safe make a better showing. The arrival and departure of trains at night at Franklin Grove show that the burglars were in that town about two hours, and they carried away with them nearly $30,000, the contents of the safe.

As dynamite is simply a mixture of nitro-glycerine and sawdust, etc., and as forcite powder, rend-rock, etc., are similar mixtures, it follows that for experimental purposes the nitro-glycerine may be obtained from them by breaking a few pounds of either of them up into small pieces in a wash bowl, covering it with alcohol, and stirring the mixture until the nitro-glycerine is extracted.

The nitro-glycerine and alcohol may then be poured off, when on adding water to it the nitro-glycerine will be precipitated to the bottom. It then only remains to pour off the water and alcohol to obtain the explosive.

Nitro-glycerine mixed with an equal quantity of alcohol is not explosive, and may be thrown into an open fire, or from a height of 30 or 40 feet onto the sidewalk, without exploding. Hence it should be so kept when not desired for use.

Nitro-glycerine will penetrate a crack .001 inch open, an opening so much smaller than

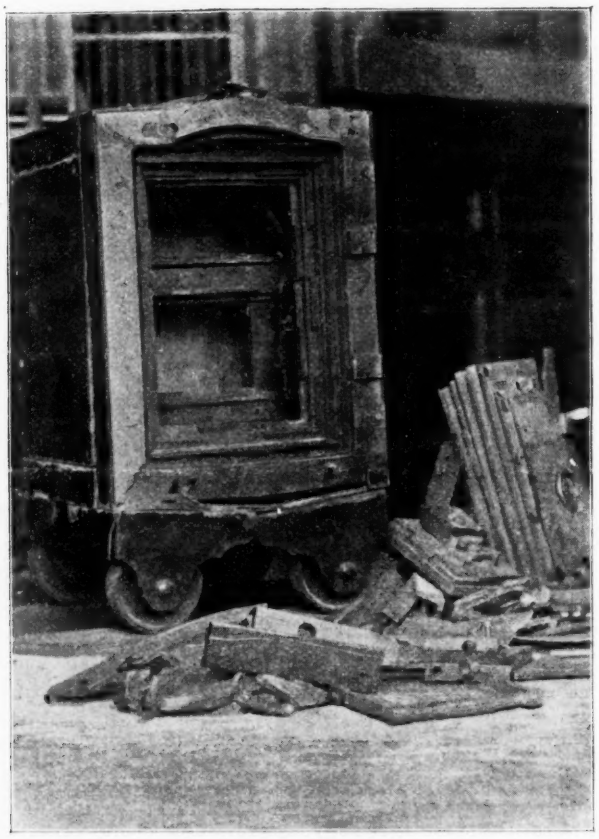


*Fig. 1.*

is possible to make in the joint of any square door that two or three ounces of nitro glycerine (all that is necessary to blow out any square or screw door) will readily run into the door joint in a few minutes.

There are round screw door safes, the outer door plate of which is ground to a tight joint with emery and oil.

But the square door safe is very often packed with cement, felt or rubber, which, when new, makes a fair joint, but neither the screw door or square packed door offer any resistance whatever to the modern burglar, as was shown in American Machinist, September 7, 1893.

Of course, it is understood that it is entirely immaterial as to what make of screw door or square door is operated on, as the principle upon which they are constructed is alike in all—plates fastened together—and therefore the methods described as having been experimentally tried on the different safes applies to all built-up safes. The outer door sheet of a screw-door safe is generally ¾ inch thick. Its edge is slightly tapered and is ground in to a joint with the safe body, making what is claimed to be a nitro glycerine proof joint. The door and front of screw-door safes are not generally very hard, and can in most cases be cut without softening. Tempering them so hard as to resist a drill means, as the maker well knows, considerable warping and distortion, necessitating corrections not easily made by grinding, hence he leaves them fairly soft. A very pretty way therefore to open any make of screw door safe with but one explosion is shown in Fig. 2.

A slot *a* about ½ inch wide is cut with a blacksmith's chisel, with handle and sledge, which operation can be performed in a *very few minutes*. This slot passes back of the inner edge of the outside door plate.

Nitro-glycerine will then readily run all around the door, and when exploded will blow the door, and occasionally the safe front out bodily.

The explosion necessary to blow out a safe door cannot be heard, or rather would not be noticed fifty feet away. In fact, many instances are on record in late bank robberies where people sleeping in adjoining houses, and distant from the blown safe by from 12 to 20 feet only, were not aroused.

The ordinary vault door is opened by the burglar in various ways, generally mechanically, so as to avoid the noise of the explosion if nitro-glycerine were used. And as such doors are opened in a few minutes by mechanical means, the necessity for using an explosive disappears. Fig. 3 shows a common method. A three-legged crab *d* is placed over the combination knob and the hook *e* engaged with the knob, as shown. By simply screwing up the hook by means of the wrench, the knob and its spindle are pulled out, or as in Fig. 4, a split ended crow-bar ("jimmy") is used, as shown, to jerk out the knob and spindle. When the spindle is pulled out, the tumblers or "wheels" drop out of place on the ordinary vault door, and it may then be opened by turning the handle *b*. On the better class of vault doors, however, the withdrawal of the combination knob and spindle will not unlock the door, and in such cases two ¾-inch holes *a* are drilled, which cut off the locking bolt, thus allowing the door to be opened.

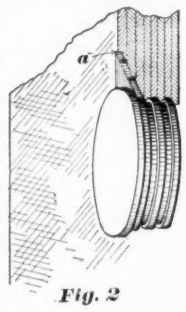



*Fig. 2*

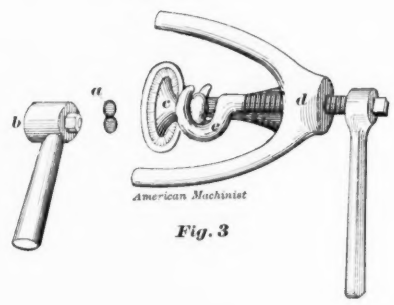



*Fig. 3*

Vault doors, like square safes, should be built of welded iron and steel, which is sufficiently hard to resist a drill. However, the expert cracksman readily softens the plate where he wishes to attack it, by the method shown in issue above referred to.

Fig. 5 shows the effect of an actual burglary which cost the bank $60,000. In this case the combination knob of the vault door was pulled out and the door opened. Nitro-glycerine was introduced, as explained. The entire operation required about one hour, probably.

Square steel bank safes have been shown by various experiments to be easily opened by methods other than the use of explosives, as if the plates of the safe are sufficiently hard to resist a drill without softening, as explained, they are so brittle as to be readily cracked on the corners with a blacksmith's chisel and sledge, and once a crack is developed, a line of wedges in the same does the rest. If not too hard to be drilled, the plates may be cut on the corners and wedges used as before, and two hours is sufficient time to strip off the entire side of a modern bank safe. But, of course, the use of nitro-glycerine is so much easier and quicker, that no other method is used today by the modern burglar.

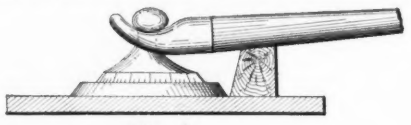


*Fig. 4*

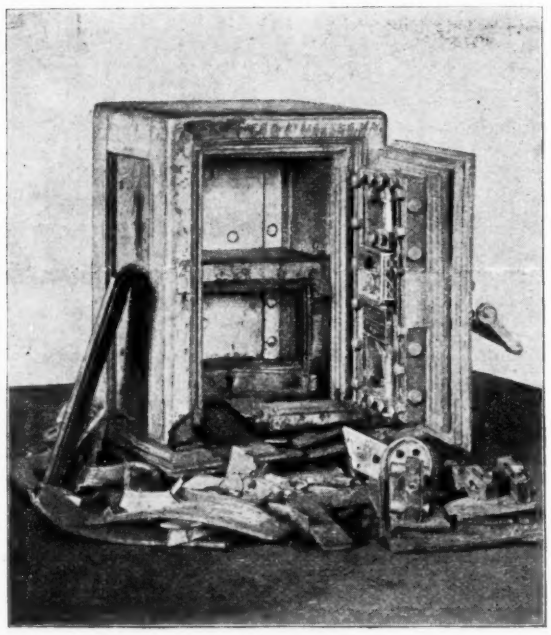


*Fig. 5.*

Mechanics of Safe Burglary.

Various makeshift methods have been devised to secure the contents of the bank safe, which, to say the most for them, are failures.

Insuring the money in the safe against burglars is one of them, but as such insurance is quite high of late, and is never made to cover notes, bonds, mortgages, private papers, etc., and as in a few of the late burglaries, the quantity of explosive used has been so great as to destroy a large part of the safes' contents, this method is rather expensive, since the collection of a note which does not exist is no child's play, even for a bank.

Electrical alarm bells too often fail in bad weather, or, as at Buffalo, N. Y., where the attendant of the Electrical Protection Co. was bribed not to notice the alarm, demonstrating that this method is not reliable. The placing of the safe in full view of the front window, so it may be in sight of every passer by at all hours, is another childish scheme, as in New York City such an exposed safe was blown open and robbed, although a watchman looked in the front window every fifteen minutes of the night. The wily burglar simply erected a canvas screen in front of the safe, on which a fair representation of the safe was painted, and behind which the burglar silently smiled as he loaded his pockets with the safe's contents and reflected on the truthfulness of the line—

"What fools these mortals be."

## The Mechanical Value of War.

By Bell Crank.

Under the above title, in the American Machinist of October 19th, Mr. Forbes advocates ideas which to the writer seem to be so opposed to the tendency and teachings of science in regard to the progress of civilization, that they should not be let pass without question.

The Peace Congress was a good thing, and if some fools were permitted to speak there it should not be surprising for they are to be found everywhere, even mechanical fools being discovered occasionally. The object of the Peace Congress was to promote the idea that the human race would be better and happier if men would refrain from killing each other by the thousands as they have often done in past times.

Surely no one should be classed as a fool for advocating so reasonable a thing as that, although fire-arm manufacturers and others similarly interested may think so.

War and war implements have undoubtedly been an important factor in the progress of man from the condition of a savage to that of the present time; but it is a question if that is not as much an effect as it is a cause. It matters not whether we accept the theory of evolution or the doctrine of special creation, we cannot avoid the conclusion that all which has been going on in the world has been necessary to bring us to our present condition, and, of course, this includes war, slavery, the inquisition, witchcraft, avarice, and all kinds of crime, but to say that any one or two or more of these is the principal cause of civilization is to attempt a generalization that does not really explain anything in particular. It would state the case more simply and broadly to say that civilization is the result of a persistent effort of the human race to reach a condition which would permit them to get what they desire with the least expenditure of energy.

To know what causes this effort we would need to know the divine purpose of life, but it is self-evident that war was not the cause, for they must have possessed this motive before they thought of killing each other.

All the foregoing may not be very interesting but is useful as a means of bringing us to ask why we should advocate either war or peace. The motive which prompts both Mr. Forbes and the writer to speak on the subject is no doubt the same; we think that what we say may, perhaps, help educate people into a belief that will influence beneficial actions among mankind.

The question, therefore, is not of what benefit war has been, but what will be best for the future—war or peace ?

We, of course, recognize the immense importance of the useful arts to the progress of man, but wish to know whether it would be best to educate people up to that standard which would enable them to have enough sense to settle their disputes in a peaceful way, and abandon the making of war material, or to continue as we have been, and make every effort to perpetuate the present system.

Because the manufacture of war material has done so much to develop the useful arts, does not prove that man would never have invented anything if he had not wanted to kill some one, nor that he would cease to invent if we were to quit making war material.

The need for food and shelter would have forced mankind to develop the useful arts, even if he had not found other men interfering with his efforts to get what he desired.

I think no one would undertake to prove that the progress of mechanic arts would be stopped if we were to cease making war materials and substitute other manufactures.

That many men make their living by

working on war materials is not a sufficient reason for continuing it, for it must always be considered if something else can be substituted that will be of more benefit to man.

Gunpowder is one of the manufactures which I am sure we would be willing to replace with something not so dangerous and of more direct benefit.

Mr. Forbes says, "It is to-day demanded that we kill our enemies with arms which are as finely finished as a watch, and in this demand can be shown work for hundreds who, in executing it, obtain support for long years, while the misery our peace friends see in war is comparatively of short duration."

This is a remarkable method of reasoning, but it will apply with equal force or lack of force to many other things. The great Chicago fire was a good thing, for the misery it caused was of short duration, while it gave employment to hundreds for many years in rebuilding the city. The Johnstown flood was very good for it gave employment to many people rebuilding the town, while the misery it caused was of short duration.

Thousands of men gain a living making intoxicating liquors, the drinking of which impairs mind and body and causes much misery, but mankind would be in much better condition if these men were employed making books for people to read.

When man raises grain on the earth, or takes the products of the earth and makes a useful implement, he is producing something for the benefit of man, but war produces nothing; it only destroys that which man has laboriously and, perhaps, painfully builded or cultivated, and destruction of useful things always means that much extra hardship for man.

Most of the war material made during the past 25 years has been simply wasted by rotting and rusting away, and yet we continue making it because the majority of the people still think the best way to settle differences between nations is to kill as many people as possible in the quickest way it can be done.

It is also very pleasing to think how refining and civilizing it is for men to go out and shoot each other by thousands, with highly polished guns made on the duplicate system of manufacture.

A petition for international arbitration addressed to the "Governments of the World" has recently been submitted to the President to be transmitted to other governments. It is signed by the commissioners from 40 different nations participating in the World's Fair, by the officials of the fair, the Commissioners of the different States and Territories, many of the chairmen and speakers of the congresses held at the fair, and many other prominent men. Its object, of course, is to try to induce all nations to agree to settle disputes between each other by arbitration instead of war. This is a good list of the fools who believe in the object that the Peace Congress was organized to promote.

And why all this effort to promote such an idea? Simply because all thoughtful students of man see plainly the overpowering burden which war and preparation for war imposes on civilization.

How much better it was for this nation and England that the Alabama claim was settled by arbitration instead of war.

We mechanics are thought to be well up in the front ranks of progress, and if we are to keep our place there we must use our ability and knowledge to promote the humane and beneficent principles of peace instead of the savagery of war.

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Work is brisk at the Brooklyn Navy Yard with, apparently, a good prospect for continuance.

### Portable Drilling and Tapping Machine.

The accompanying cut illustrates a portable drilling and tapping machine, which can be operated at any distance or in any direction from the countershaft, can be readily attached to the pieces in which the holes are to be drilled and tapped, and is easily handled by one man. The size shown —No. 8—will drill holes up to 1⅛ inches in diameter and will drive a 1⅛-inch tap in cast iron. It has four changes of speed for drilling and two for tapping, two of the speeds being used for backing the tap out, which is done much faster than the tap is fed in. When the hole has been tapped deep enough the motion is reversed by simply shifting the handle shown on the cut just below the driving wheel. In drilling or tapping, the power can be instantly stopped by moving this handle to a central position. The feeding arrangement is patent differential geared and is entirely inclosed, being protected from dirt and damage, and has quick return; this gives the free movement of the spindle up and down required for tapping, the tap feeding itself in and out of the hole same as with a stationary drilling machine.

The spindle has a feed of six inches and the hole in the end is No. 4 Morse taper; the post is 36 inches long, the radial arm 12 inches long. The clamps open 10 inches. Weight, 115 pounds. Countershaft, rope, etc., go with the machine. It is made by Albert L. Colburn, New Haven, Conn.

Portable Drilling and Tapping Machine.

### Eight-roll, Double-cylinder Flooring Machine.

We illustrate by the accompanying engraving a new flooring machine, which finishes boards top and bottom and tongues and grooves the edges simultaneously.

As will be perceived, the frame of the machine is of the plate form—very heavy and substantial, special pains having been taken with this machine to make it very substantial and to allow work to be crowded through it at a very rapid rate.

All journals, shafts, gears, screws and bolts are made to standard sizes, and all parts of the machine are made upon the interchangeable plan.

The cylinders are made from solid steel forgings of fine quality, have six sides for carrying two, four or six knives, as may be required, each side with a chip breaking lip for working cross grained lumber. The journals are 3 inches in diameter, lead—lapped and run in exceptionally long and heavy bearings. Each cylinder is driven by two belts, each pulley having a taper bearing and being secured by a wrought nut. The bearings of the upper cylinder are yoked together, and are placed on planed stands cast solid to a bed plate extending across the machine. These stands are fitted with a groove in which the bearings are bedded and thus always retained in line.

The lower cylinder is placed just beyond the upper one, thus bringing the material to an exact size before it is tongued and grooved, and bringing the top and bottom cuts as close together as possible when using bits on the cylinders for making two pieces of flooring from one board. This class of work was impractical with the old style of construction, because the lower cut was made too far away from the top cutting point; the tendency of the board to lead out of a straight line preventing the division of the board on the line of the top cut.

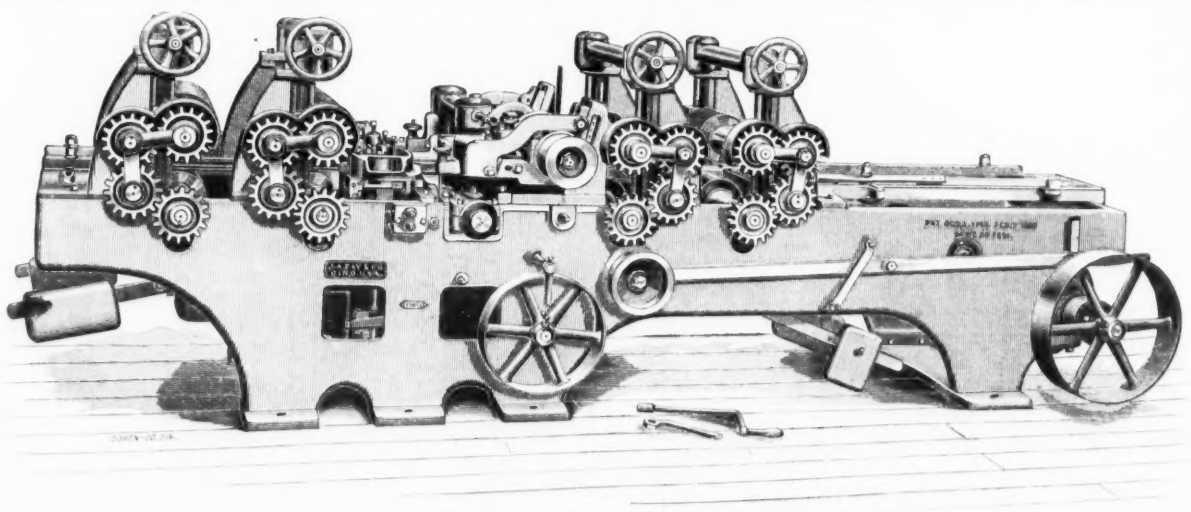
The automatic self-acting pressure bar before the cut of the upper cylinder on the feeding in side, is attached to arms that swing eccentrically to the periphery of the cylinder, insuring safety from contact with the cutters.

The bar after the cut of the upper cylinder adjusts itself vertically and is self acting in its operation. Both bars are adjustable to and from the cylinder to give room for different lengths of cutters required in making moldings, drop sidings, etc. The bed under the cylinder has a plate that can be detached for re-planing or adjustment. As the lower cylinder is placed so close to the upper cylinder, it permits the attachment of the pressure bar over the lower cylinder, by swinging arms, to the upper cylinder frame, permitting it to rise and fall with the cylinder whenever the position of the latter is changed; thereby retaining its proper relation to the material, no matter what the cut may be. This bar has a separate vertical adjustment and also a lock attachment for holding it in the proper position after being once set.

The matching works are of the most substantial character. The cutter spindles are 1¾ inches in diameter where the cutting heads are applied, run in self-oiling bearings, and are adjustable independently or simultaneously across the bed plate to any desired point, so that wear of cutters can be equalized. They have a vertical adjustment in the lower bearings to take up wear in the spindles, and are provided with lock attachment for holding them in position when once set. Unless otherwise provided for, a pair of four-wing, gun-metal matcher-heads fitted with a set of solid milled matching cutters for standard flooring, are sent out with the machine. Slotted jointing heads, shimer, flooring and ceiling heads can also be furnished. An improved automatic weighted chip breaker is applied to this machine. It is hinged to the matcher hanger, and as the pressure is produced by a weight, it is uniform at all times whether the cut is heavy or light. It swings eccentrically from the cutters, and while it is arranged to work very close to the edge, it can never come in contact with the cutters.

The feed works are very powerful, consisting of eight rolls 8 inches in diameter, two pairs before the cut of the upper cylinder and two pairs after the cut of the lower cylinder. These carry the lumber entirely through and away from the cutters. They are mounted on planed upright stands fitted with pivoted boxes, and connected by heavy expansion gearing. These gears have gun metal bushings and steel links on both sides connecting with the upper and lower roll shafts, and will open to receive material 6 inches in thickness. The feed is controlled by a binder operated from the feeding end of the machine. The machine is made to work either 8 inches, 14 inches, or 18 inches in width, to 6 inches thick, and is regularly supplied with pulleys for 62 feet and 80 feet per minute. One set of heads and knives and a full set of wrenches are furnished with each machine.

The builders are J. A. Fay & Co., Cincinnati, O.



Double cylinder Flooring Machine.

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In a report by R. R. Tatloch, Esq., public analyist and gas examiner for the city of Glasgow, on the smoke absorption plans of Colonel Dulier, it is claimed that the plan works very successfully, preventing, almost entirely, the escape of soot, and reducing very largely the escape of sulphurous acid. Following is a brief description of the plan employed: "As the gases pass from the furnace they are assisted by a jet of steam in the ascending flue of the apparatus, at the pressure of the boiler (80 to 100 pounds). The object of employing steam is to assist in the condensation of the tarry hydrocarbons, and to saturate the mineral dust with water vapor in order that they may be rendered more liable to precipitation by the subsequent treatment. The gases are passed through the apparatus, which consists of an ascending flue of masonry (already mentioned) lined with fire bricks, and a descending flue made of steel plates dipped at a high temperature in a tar composition, the lower part being connected with a tank from which a drain carries off the residues and water. As the gases pass through this apparatus they are met at the top of the descending flue by a fine spray of water, which is produced by forcing water at 100 pounds pressure through nozzles, by which means the soot and dust are precipitated."

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According to the *Railway Review*, the Pennsylvania Railroad Company has in operation at Alliance, O., a machine which shears up old railroad ties, telegraph poles and the like, fully four times as fast as they can be cut with a saw.

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Air goes from a level of higher pressure to one of lower pressure just as naturally as a sled goes down hill. If this was always thought of in efforts at ventilation it would save many failures.

## On the Cultivation of the Inventive Capacity by the Solution of Constructive Problems.

By Leicester Allen.

Messrs. W. S. Huson and H. B. Cowper, of Taunton, Mass., have jointly contributed the solution to Problem No. 5 shown in Figs. 1 and 2. I suppose that technically I shall be obliged to concede that this solution meets the requirements of the problem as enunciated; yet, at the same time, I think that it is only a modification of two cranks on each shaft set at an angle with each other, the cranks being driven by two connecting rods, a device which was expressly excluded in the conditions to be observed. The gentlemen who have sent in the solution make use of the following expression in describing their device :

"The connecting rods are not in the same plane, the rod *A* being carried upon hubs of *arms B* which are secured to the disks *D*, the rod *C* being carried at the free ends of the arms *B*, on opposite sides of the arms from the hubs which carry *C*."

It may be thought by some that what these gentlemen style an *arm B* is not in fact a return crank. This, at least, appears to have been the opinion of Mr. W. P. Tarbell, of Milford, N. H., who has sent in the same solution. I think, on the contrary, that either disk and the hub to which *A* is connected form a crank, and that the arm *B* is substantially a return crank. Mr. Tarbell, in addition to the solution named, sends in two others, one of which, shown in Figs. 3 and 4, is a modification of that shown in Figs. 1 and 2, and the other, shown in Figs. 5 and 6, is entirely unique, no other which has been offered at all resembling it. With regard to the one shown in Figs. 3 and 4 it is sufficient to say that the bar *E* connecting the crank-pins *C D* in the same manner as the bar *A* connects the hubs of the arms *B* in Fig. 1, extends beyond the disk *B*, Figs. 3 and 4, and is pivoted to a crank *G*. Mr. Tarbell adds to this description the following, by which it will be seen that the bar *F*, though apparently the equivalent of the bar *C* in Fig. 1, is really a stationary bar:

"The arms *c' d'* are fastened to the crank-pins *C D* outside the bar *E*, and, in turn, the other ends are pivotally held to the bar *F;* but, in this case, the pivot centers coincide with those of the disks; thus the bar remains in a fixed position when the disks are rotated. The crank arm *G* is held and pivoted to *F* at a point directly in line with the disk centers, the other end to *E* as shown. Taking the disk *B* for the driver the velocity and directional ratio of the two disks will be the same. In operation this device is the same as Mr. Allen's solution, but the third crank is differently supported.

"The solution contributed in Figs. 5 and 6," Mr. Tarbell states, "is offered as filling every requirement of the problem in a simple manner, providing also for all the reverse movements that have been referred to, without adding or subtracting a single element to or from the device.

"It is submitted *merely* as *another way* of getting around the restrictions—not for any merit as a mechanical movement."

"*A* and *B* are the disks and *E* the bar connecting them. *C* and *D* are rods held to opposite sides of the disk *A* in a position suitably related to the crank, as will be shown. Weights, *W' W''*, are fitted to slide freely on the rods a certain distance. The weights operate as follows to pass the crank by the dead centers:

"In Fig. 5, with the crank *x* of the driver moving as indicated, the weight *W'* is positioned to assist the other crank past the center in the direction indicated for the disk *A*, and when the opposite center is reached, the crank is again assisted by the center, this time by the other weight which has shifted its position on the rod *D*. This will be repeated as long as the driver *B* moves in the same direction. Should *B* rotate in the opposite direction the follower *A* will rotate the same as before. If the weights are made to occupy a position indicated by the dotted line *m n* then the disk *A* will rotate in the opposite direction from that indicated by the arrow, whether the disk *B* rotates as indicated or oppositely. Fig. 6 shows the weights positioned to the crank as first mentioned with the driver *B* rotating in the opposite direction. The disk rotates in the same direction as at first, the bar *E* assuming the position shown. This is supposing in each case that the disk centers are horizontally placed to each other; otherwise a different position of the weights would become necessary in order to secure the assistance of gravity past the centers. The power taken from the follower *A* would, of course, determine the size of the weights and their position on the rods. The details could, no doubt, be worked up to some advantage; but, however, I believe the device fills all the requirements, and that is all it was designed for."

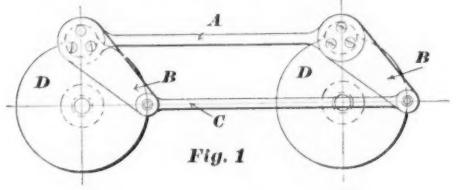


Fig. 1

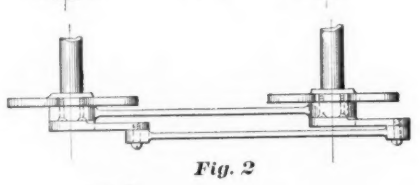


Fig. 2

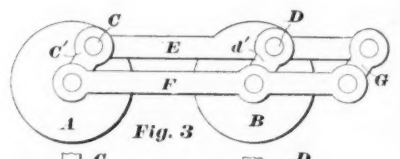


Fig. 3

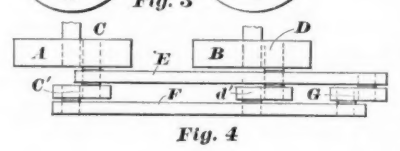


Fig. 4

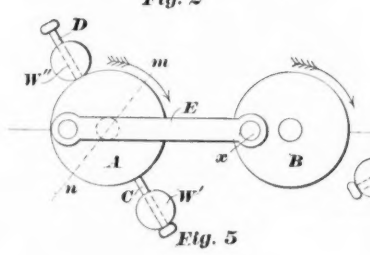


Fig. 5

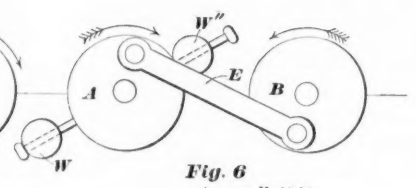


Fig. 6
American Machinist

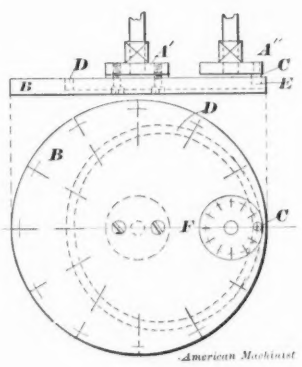


Fig. 7
American Machinist

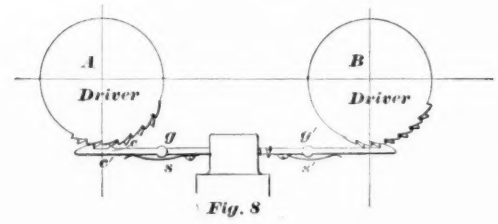


Fig. 8

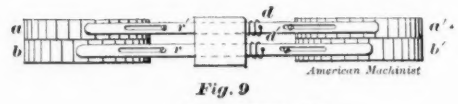


Fig. 9
American Machinist

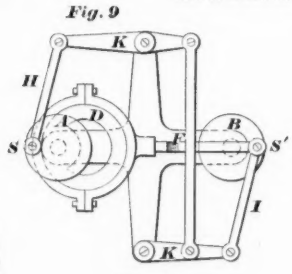


Fig. 12

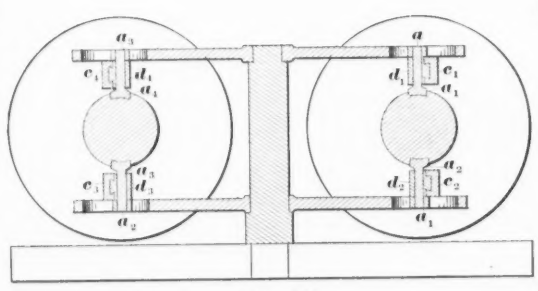


Fig. 10

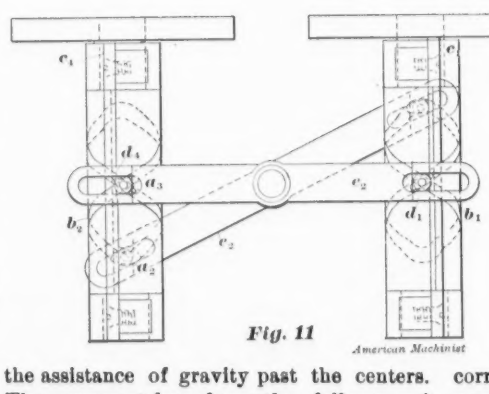


Fig. 11
American Machinist

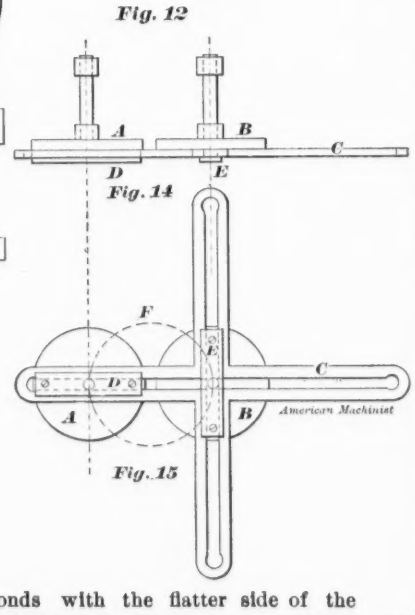


Fig. 14
Fig. 15
American Machinist

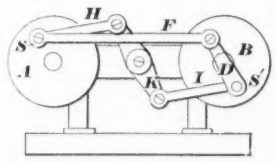


Fig. 13
American Machinist

In Figs. 8 and 9 is presented a solution contributed by Mr. F. J. Hoxie, of Phenix, R. I. "The shafts of *A* and *B* each carry a double escapement wheel. The two wheels of each set and both sets have the same diameter and number of teeth. The two wheels of either set, *a b* and *a' b'*, are so placed that the teeth of one come midway between the teeth of the other. The escapement rods *r r'* are urged towards the right by spiral springs *d d'*. The pawls engaging with the driver have bosses *c c'* at a distance from the face of the pawl equal to the pitch of the teeth. The pawls at each end of the rods are jointed and held against the wheels by springs *s s'*. The height of the bosses *c c'* is such that they will disengage the pawl when it has passed the lowest point in the wheel by a distance equal to the pitch of the teeth."

There seems a strong analogy between Mr. Hoxie's solution and that of Mr. Slocomb, or, at least, that one presented by the latter gentleman in a former number, wherein a ratchet movement was employed, and it might be profitable to study these two movements together, but I must economize space.

A solution offered by Mr. A. Schiefer, of Fern Bank, O., is so curious and ingenious that I would be glad to present it, notwithstanding it violates the condition that friction wheels cannot be allowed. But, as I am anxious to conclude Problem No. 5 in the present article, I am forced to pass this device without further remark.

Figs. 10 and 11 are respectively a sectional elevation and plan of an ingenious solution contributed by Mr. R. B. Cochrane, of Madison, Wis. A similar solution has also been contributed by Mr. James P. Hayes, of Meriden, Conn.

In this device the motion is transmitted to the driven disk by the nuts or crescents $a_1$ $a_2$ $a_3$ $a_4$, respectively, working in the cams $b_1$ $b_2$. The nuts are fitted in the slides $d_1$ $d_2$ $d_3$ $d_4$, which run in the guides $c_1$ $c_2$ $c_3$ $c_4$. These guides are in such position that the nuts are over the centers of the cams.

One pair of nuts will always be in the working part of the slots carrying the other pair by the dead point. The grooves are rounded at the end so as to allow the nuts to turn.

Mr. Cochrane adds to the above description the following :

"By changing the nuts in the driven cam when the lever *E* is in the position shown in the plan, from the right to the left-hand groove, or *vice versa*, the direction of the driven disk may be changed. This was an afterthought, and I have shown no way in the drawing for easily changing it."

An attempted solution by Mr. Charles S. Beach, of Bennington, Vt., upon examination, proves inoperative. I have not space to analyze it to show the inoperative character of the device.

Mr. W. H. Chappell, of Chicago, has criticised Mr. McCabe's solution given in issue of September 28th, showing its impossible character. The slight criticism I made in presenting Mr. McCabe's device called his attention to its defects, and with reference to it he has written to me the following communication:

"Your slight criticism of my solution of Problem No. 5, shown in Figs. 3 and 4 in issue of September 28th, brought me to a realization of the fact that I had made, perhaps, even a greater mistake than did Mr. Tobin in his sleeve-and-eccentric solution. You expressed a doubt that the velocity of the disk *B*, as dependent upon the transmission through the links *H* and *I*, will harmonize with the motion imparted by the eccentric *D* to the disk *B*. Upon investigation it is very clear to me that it will not.

"Without sending any new solution I will endeavor to rectify my mistake. I might change the position of the centers *s s'* as you suggested, but the eccentric motion demands that the links *H* and *I* produce a uniform velocity of the disks through the rocker *K*, which they are unable to do. So I send you two sketches, Figs. 12 and 13, in which I have endeavored to so place the links *H* and *I* that they will operate, re-

spectively, on the quarters of their cranks, in which a crosshead connected to their extremities would be thrown the greater part of its travel, and on the quarters in which the crosshead would be thrown the lesser part of its travel at the same time. This is the point I neglected in my former solution.

"Assuming that the crank *A* is started to the left, Fig. 12, I have *H* operating on the long quarter of the crank *A* and *I* operating on the short quarter of the crank *B*, and before turned far a conflict will occur. I have overcome this difficulty in Fig. 12, by making the rocker *H* in two parts and placing them as shown. In Fig 13 I have placed the cranks on opposite sides of the rocker *K*, using the return crank *D* instead of an eccentric.

"It may be seen that these devices work on the same principle I intended to use in Fig. 3, September 28th, and I have lettered their respective parts to correspond. I submit them to your judgment in regard to their fulfilling the requirements of the problem."

There is no doubt in my mind of the operative character of Mr. McCabe's device, shown in Fig. 13, but before deciding with reference to that shown in Fig. 12, I should desire to trace the movement through the entire circuit, which I have not yet found time to do.

Some interesting remarks by Mr. McCabe upon solutions previously given, I am compelled to forego in order to accomplish my purpose in the present article. As Mr. McCabe preceded Mr. Chappell in criticising the solution in question, I omit Mr. Chappell's communication, but will remark that the latter also has contributed a solution consisting of a third crank placed in triangular relation with the disks substantially like that submitted by Mr. Alfred T. Brown, and others.

The last solution which I shall present, and with which I shall conclude the discussion of Problem No. 5, has been presented by Mr. Albert Kingsbury, of Durham, N. H. It is illustrated in Figs. 14 and 15, respectively a plan and side elevation. Mr. Kingsbury writes as follows:

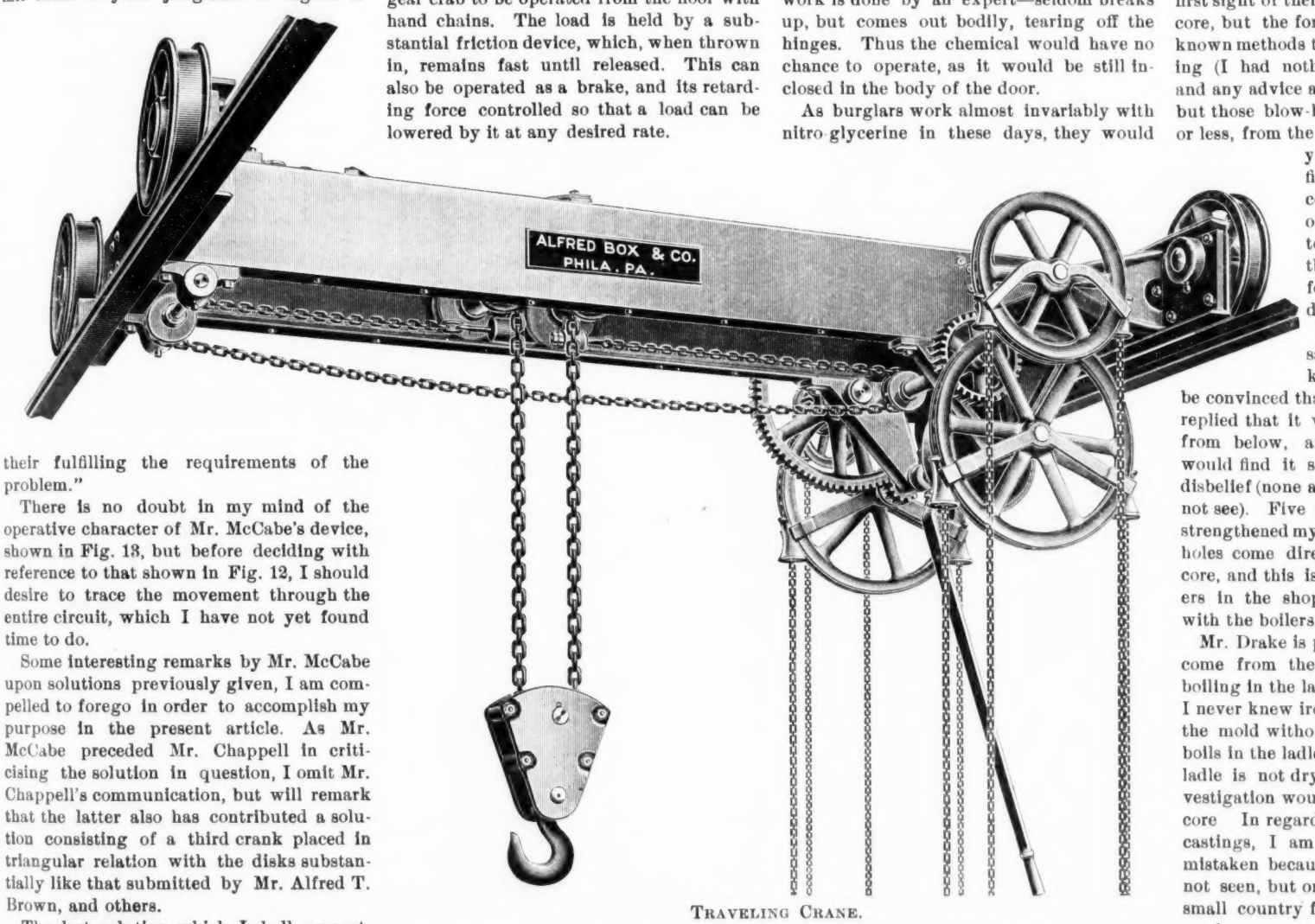
"The cross-shaped intermediate connector *C* has two slots planed through it (not necessarily at right angles to each other, as shown). In each of these slots works one of two T-sectioned sliding strips *D E*, which are screwed respectively to the disks *A* and *B*. If either *A* or *B* be driven from the source of power in either direction, the cross-shaped connector *C* will follow in the same direction, and it will drive the remaining disk in the same direction, the angular velocities of all three being the same. The axis about which *C* revolves is parallel to those of the disks, but is not stationary—it revolves about an axis of its own in the circle *F*, with an angular velocity twice that of the disks."

With reference to this solution it appears to me that, if in the position shown in Fig. 15, the disk *B* be assumed as the driver and turned, say, to the left, or "counter clockwise," to adopt Mr. Oberlin Smith's term, the effort would be resisted by the strip *D*, and that hence this would be a dead point position. At a corresponding point the same position would be assumed by the sliding strip *E* with reference to the disk *A* were the latter made the driver. However, I think young mechanics may find a profitable study in this movement, and it is very suggestive of certain possibilities in circular motion.

Now, it was my intention to announce a problem suggested to me by Mr. Fred J. Miller, one of the editors of this paper, in his "Columbian Exposition Notes," printed in issue of July 20, 1893. I find, however, that the addition of this problem will require some preliminary explanation, and altogether it would extend the present article to inconvenient limits. I will, therefore, make a separate morsel of the problem referred to, which will be known as No. 6, and present it by itself in a future issue.

## Traveling Crane.

The illustration on this page is of a traveling crane, which is provided with a spur-gear crab to be operated from the floor with hand chains. The load is held by a substantial friction device, which, when thrown in, remains fast until released. This can also be operated as a brake, and its retarding force controlled so that a load can be lowered by it at any desired rate.




Traveling Crane.

This style of crane is built for any capacity from three to ten tons and with any desired length of bridge.

All bearings are bushed with a shell containing anti friction rollers, making the crane light running and very easy to operate. It is built by Alfred Box & Co., Philadelphia, Pa.

Census bulletin No. 67, which deals with manufacturing establishments and industries, shows that New York State has 65,840 manufacturing establishments, with an aggregate capital of $1,130,161,195, employing an average of 850,084 persons, and paying wages amounting to $466,846,642 annually; consuming materials costing $871,264,085 a year, and turning out products worth $1,711,577,671. New Jersey has 9,221 establishments, and Connecticut 6,822.

The industry represented in all the United States by the greatest multitude of establishments is blacksmithing and wheelwrighting; this has 28,000. The most productive industry, in the sense of turning out products of the highest aggregate value, is flour and grist milling; this produces $513,971,474 worth of wares in a year. The industry employing the largest number of persons is lumber, which, exclusive of planing-mills, gives occupation to 286,197 employes, but the foundries and machine shops, which stand next in rank with 247,754 employes, surpass everything else in the money they dispense yearly in wages—$148,389,063.

## LETTERS FROM PRACTICAL MEN.

### Safe Burglaries.

*Editor American Machinist:*

I noticed in your issue of March 9th some suggestions by William Kent on burglar-proof safes, chemicals being used as an adjunct. Now, the idea is quite old, and when such safes were proposed some time since, they were known as "stink pot" safes. One such illustration will answer for all of this type. It was proposed (and patented) to make a safe and place in the walls of the safe glass tubes filled with some noxious and horrid smelling chemical. The doors were also to be fitted with the same arrangement. Now, the square safe door when blown out by nitro-glycerine—if the work is done by an expert—seldom breaks up, but comes out bodily, tearing off the hinges. Thus the chemical would have no chance to operate, as it would be still inclosed in the body of the door.

As burglars work almost invariably with nitro-glycerine in these days, they would have only to provide themselves with a diver's helmet, so that in case the chemical was set free its fumes could not enter the burglar's lungs or eyes during the short time he would be occupied in filling his pockets with the safe's contents.

Or, if mechanical burglary was resorted to, the device used for tapping water mains under pressure could be used, thus cutting a hole of 4 inches diameter through and into the money vault, and forcing a thimble into the hole before removing the drilling rig. In this way the chemical bottles could be prevented from becoming harmful to the burglar. A mere tyro in burglary would head off dripping vitriol with a wooden shield. The report issued by the government lately on safes has demonstrated clearly that no type or kind of safe, if built of laminated plates, with either square or round door, is burglar-proof for thirty minutes. The one safe which showed itself able to resist all attacks made on it was a round, chilled iron, ordnance metal structure, built by William Corliss, of Providence, R. I., a brother and partner of the late George H. Corliss of engine fame.

It might be added that electrical bells and alarms have not proven an unmixed joy to the banker. They operate mysteriously in rainy weather, and the attendant of an electrical burglar alarm company was lately bribed by burglars on a rainy night, in a large New York State city, not to notice the alarm they made in robbing the bank.

After all, the only dependence which can be relied on is a simon-pure burglar-proof safe. Watchmen or burglar alarm attendants can be seduced or knocked on the head—and the real safety is a safe which cannot be opened burglariously. R. B. S.

### Sound Castings.

*Editor American Machinist:*

I am a plain every-day molder, and, therefore, am much interested in the question of sound castings. With your permission I will "pour off" what I know on the subject. Some five or more years ago the shop where I am employed commenced to make boilers for steam heating. I made the first casting and have worked on them, more or less, ever since. Soon after getting fairly started on them trouble commenced in the shape of blow-holes as described by Mr. Drake. At first sight of them I said they came from the core, but the foreman said *no*. I tried all known methods to get rid of them by molding (I had nothing to do with the core, and any advice about that was not wanted), but those blow-holes have been there, more or less, from the start to this date. Several years ago I became so satisfied that they came from the core, that I offered to give one day's time to experiment to investigate the matter, but the foreman evidently preferred theories to facts and declined the offer.

The last time anything was said to me about them, I, knowing that he would not be convinced that they came from the core, replied that it was evident that they came from below, and that sooner or later he would find it so, but he shook his head in disbelief (none are so blind as those that will not see). Five years' experience has only strengthened my convictions that these blow-holes come directly or indirectly from the core, and this is the verdict of all the molders in the shop who have anything to do with the boilers.

Mr. Drake is positive in his case that they come from the iron, and quotes the iron boiling in the ladle. Now, in my experience I never knew iron to boil in the ladle or in the mold without good cause. When iron boils in the ladle I take it as a sign that the ladle is not dry, and a little intelligent investigation would show why it boils on the core In regard to sulphur causing holes in castings, I am not going to say a man is mistaken because he has seen what I have not seen, but once on a time I worked in a small country foundry where the principal work was cast-iron plows. The shop was new, and in the very small scrap heap was a lot of old axes. *I have seen* the Old Man put one of the old axes and about one-third of a roll of brimstone into a ladle, and I have held that ladle under the spout and caught 60 or 75 pounds of iron, and have seen the whole stirred up and thoroughly mixed; then poured my mold for a plow casting, the Old Man's idea being that the sulphur made them hard and the old axe made them tough. Perhaps it did. I did not test them to find out, but if there were any holes in those castings that were not intended to be there, I never saw them. Perhaps the wrought-iron and bit of steel in the old axe counteracted the *holing* of the sulphur, who knows? Now, I wish to ask some questions. Will a core that is burnt so that you can rub it off with your hand make as good a casting as one that is dry without being burnt? Is it *good* to ram the core sand into the boxes *hard?* Is it the general practice to compel molders working by the piece to mix their own facing sand?

John R. Tracy.

### Making Drill Jigs.

*Editor American Machinist:*

A drill jig to be of any value whatsoever must be made correct, and in order to make them so, the best methods should be employed, and it strikes me that there is a

better and cheaper method than that described by Mr. McGregor in your issue of February 22, 1894. Every milling machine that occupies space in a tool room can have its platen moved in three directions, viz, it can be moved horizontally at right angles to the spindle, it can be made to approach or recede from the spindle, and finally it can be moved either way, vertically. Now, then, if we fix the position of the platen with reference to the spindle, we may drill as many holes in a piece as we please, if such a piece be fastened upon the platen in a suitable manner, simply by having a drill in the chuck upon the spindle, and by moving the platen nearer to the drill. The position of any other hole may be obtained accurately by moving the platen up or down, or forward or back, as the case may be, by simply turning the respective screws the necessary number of times. Of course, a dial must be fastened at the end of the platen, and an indicator or hand at its screw, so as to register the number of revolutions of the screw, and consequently the distance the platen has been moved. Immediately after a given hole has been drilled it must be bored out by means of a boring tool, similar to those used in lathes, held in the chuck upon the spindle. Here we need no preliminary bushings, need not to depend upon our eye-sight, which perhaps is the poorest of our senses, but get our work with mathematical precision, cheaply and quickly within reasonable limits, and provided we have made no mathematical error. "Yes, this is very nice, but the screws of milling machines are not correct," I hear some one say. "Well, what of it?" The screws can only be too long or too short, and all there is to it, is to find out which the case is. It is not very likely that there will be local errors of pitch that will amount to much, at least not in the screws of firms of reputation. When we once know in what condition the screws are, it is an easy matter to provide such means as will compensate these errors for every turn. A dial is generally fastened in front of the knee, and its functions are to enable us to elevate or lower the platen, or to bring it nearer the spindle or withdraw therefrom by a certain number of .001 inch. Why, then, is not a dial fastened, or one provided that can be so fastened, to the platen? It seems to me this would be of just as much value as some other things now so often brought to notice; it certainly would add to the many values attributable to milling machines. Again, of what use are these dials, if the screws are permitted to vary, or to be permitted an inaccuracy of as much as .004 inch or more in 12 inches? Indeed, the correctness of screws of milling machines is just as important as all dial plates taken together that one can see on milling machines. The dials are also entirely too small; their size should be as large as possible, thereby reducing the possible errors proportionately to a minimum.

E. Lawrenz.

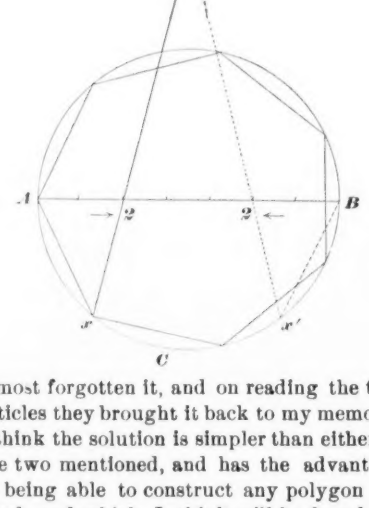
### The Heptagon.

*Editor American Machinist:*

Although not a direct subscriber to your valuable paper, nevertheless I carefully read its contents with great interest, as it regularly comes to our club. I very carefully perused the two articles on "The Construction of a Heptagon," by Mr. Bunnell and Mr. Barth, and although the latter is more correct I think the former is simpler in construction and easier to remember.

Some years ago, while working on the same problem I accidentally discovered a solution to it. It may be an old idea, but, so far, I have never seen it in any of the text-books. The solution is not only simple in construction but has the further advantage of being universal in application and accurate enough for all practical purposes. I have never determined its error, if any, but will investigate it. Without going into details of its discovery I herewith give the solution:

Describe the circle $A\ B\ C$, in which the heptagon is to be constructed; draw a diameter $A\ B$, and from the ends of the diameter with $A$ and $B$ as centers and radius $A\ B$, describe arcs cutting each other in $D$. Now divide the diameter $A\ B$ into seven equal parts (or as many parts to correspond with the number of sides in the polygon desired). From $D$ draw a line through the second division from either end of the diameter to the circumference of the circle at $x$ or $x'$. Join $A\ x$ or $B\ x'$ and $A\ x$ or $B\ x'$ gives one side of the desired figure. The others can be laid out with a compass. It is many years since I worked this out, so that I had




almost forgotten it, and on reading the two articles they brought it back to my memory. I think the solution is simpler than either of the two mentioned, and has the advantage of being able to construct any polygon desired, and which I think will be found accurate enough for all ordinary purposes. A friend of mine some time ago found that the radius of a circle, minus one-fifteenth of the diameter, will give the side of a heptagon for that circle with very little error.

Jas M Dupries.

### Miner's Compass or Dip Needle.

*Editor American Machinist:*

May I be allowed to state in reply to Query 126, J. W., Boston, Mass., that there is an instrument made and regularly used whereby the presence of *iron* ores may be detected? It is called a *miner's compass* or *dip needle*, and consists of a balanced magnetic needle, which revolves in a vertical plane within the graduated rim of a flat box with glass sides, which is held in the hand by a ring. When no iron is near, the needle being unaffected by any attraction, assumes a horizontal position, but "dips" at once on being brought into the invisible presence of iron ore, and by the quantity or measure of its dip makes its location apparent.

Of course, any proposed means for detecting the presence of gold or silver is to be treated with the same amount of credence which an intelligent person would attach to the divining rod you describe.

Wm. Cox.

### Central Blast Cupolas.

*Editor American Machinist:*

We note in the American Machinist of March 8th, on page 6, an article headed "Central Blast Cupolas—Suspiciously Large Melting."

We beg to say that the statement we made through your paper of December 14th, in regard to melting about 14,000 tons of iron in a cupola with only one lining, is entirely correct, and in further confirmation of this statement we would ask if you will be kind enough to publish the enclosed blue print copy of a letter signed by W. C. McMillan, Managing Director of the Michigan Peninsular Car Company, obliging,

Yours very respectfully,

J. H. Whiting, Pres.

Michigan Peninsular Car Company.

Detroit, April 10, 1893.

Detroit Foundry Equipment Co.,
Detroit, Mich.

Gentlemen: Replying to yours of the 8th inst., we beg to say, that we have in our wheel foundry three Whiting patent cupolas, in our soft foundry, two, and in our pipe foundry, one. We melt in the wheel foundry about 150 tons of iron daily, this being all run from one cupola. In the soft foundry we melt about 100 tons daily, this also being run from one cupola. When operating the pipe foundry we melt 60 to 70 tons daily, making a total capacity of about 320 tons of iron per day.

The iron is of excellent quality, having great fluidity and making clean castings, very soft and fine in quality. The average ratio of iron to coke is ten to one.

By using a good quality of brick and following the directions in your "Practical Hints," we melt from 13,500 to 14,000 tons of iron in one cupola without re lining. Judging from my investigation and experience with cupolas, I am convinced that "the Whiting" is superior to any and can recommend it most highly for all purposes.

Yours truly,

W. C. McMillan,
Managing Director.

### Strength of Beams.

*Editor American Machinist:*

I have before me now the American Machinist of February 22, 1894, containing two articles on this subject in reference to the position of the neutral axis. I have not yet read Mr. Mackintosh's original article. A number of years ago I investigated this question for myself, and came to some conclusions which I have never seen expressed or refuted. I express them now, so that my error may be pointed out, if it exists.

I consider the greatest difficulty in learning from another to be that of understanding just what idea the author meant to convey. It is difficult to express an idea so clearly that the student may receive only the idea intended. Whether a statement is true or not depends upon what the assumption of condition is, and these conditions are often assumed without being expressed. Also, I consider Merriman, Rankine, Thurston and others to be practical as well as theoretical, therefore, when I, sometimes, in working out a subject for myself, arrive at conclusions different from what I have read from standard authorities, I do not feel sure but that we may both be right if we accept the same condition when considering the other proposition.

Now, then, we have Hooke's law, "stress is proportional to strain," within the elastic limit. When a beam is bent there is a strain due to tension on one side, and a strain due to compression on the other side, and the strain occurring to any particular fiber is proportional to its distance from the neutral axis in the majority of cases (solid beams) wherein the resistance to longitudinal shearing or slipping is greater than the tension or compression.

Note—An exception would be if a series of boards were laid one on another, and stuck together with a weak glue, and a bending stress applied so as to cause the boards to slip, when they would look as shown in Fig. 1, whereas if the glue had held, it would have looked like Fig. 2.

We will deal only with those cases where the strain is proportional to the distance

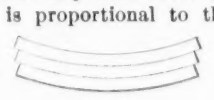


*Fig. 1*

*Fig. 2*

*Fig. 3*

from neutral axis, but for the sake of argument, take each side by itself. Let us assume our beam to be rectangular in section, hence the center of gravity is in center of section.

*Assume also that it is of such material that the modulus of elasticity is the same for tension and compression but that the limit of elasticity will be reached earlier for tension than for compression.* When *such* a beam is bent, the fibers on one side are stretched the same amount as they are compressed on the other, but if this strain is increased a point will be reached where the fibers in tension will give way, because they cannot stand any more stretch than they already have. In the above case the neutral axis is in the center of gravity, although the tension side was weaker. Call above Case 1.

Now, consider a more hypothetical case wherein the modulas of elasticity of one side—say tension, for example only—is much less the modulus of the compression side. For than argument only, assume that compression was twice that of tension, this means that if a force be applied to cause tension only, the stretch would be double what it would be if an equal force be applied to cause compression only, hence if the two forces be applied at once by the bending of this particular beam, it is plain to me that the neutral axis will be nearer the compression side, for it will be the line on which there is neither tension or compression. I can illustrate the idea by Fig. 3. A certain pull would make a stretch equal to $T$, and it is agreed that the thrust on the other side will be equal to the pull on the tension side, but because the *modulus of elasticity* is greater for compression than for tension, the compression is only $C$ and the straight lines show that the neutral axis is at $n$. When the beam gives way, it will be on the side that reaches the elastic limit first, not necessarily the tension side. Callth is Case 2.

Case 1 applies very approximately to most all cases.

The modulus of elasticity is generally given (or near enough) the same for both tension and compression, but for some material I think I have seen it given as 29,000,000 for tension or compression and 28,000,000 for the other stress. I have not the figures handy now, but the point which I would make is that the figures are large and taken coarsely, and the difference in most materials of engineering is only about three per cent., and finally, it is impossible to make any short formula which can be used quickly for example on a slide rule, unless we do assume the neutral axis to be in the center of gravity.

By the "strength of a beam" we generally mean the modulus of rupture at the time of its elastic limit being reached, or we might mean the greatest bending moment to which it might be subjected. When a beam is tested and the bending moment under which it gave way is noted, and also its cross-section, we assume the neutral axis to be in the center of gravity of section, and figure back to find a fiber stress which would exist under such circumstances; and when it is published that a beam broke with a modulus of rupture of so much, we all know just what that means, and we can expect a similar piece of material to yield under about the same bending moment.

Practice tells us to figure on different working fiber stresses for different kinds of work, and we are therefore all right in our results, whether we have figured upon the actual stress or not.

I claim that theoretically:

The neutral axis will be in the center of gravity of a section of homogeneous material when the modulus of elasticity is the same for tension and compression.

The neutral axis will be nearer to the side having the highest modulus of elasticity. The position of the neutral axis is independent of the elastic limit.

The sum of the moments of the stresses on one side of neutral axis is equal to sum of moments on other side.

The strain begins when the stress is applied. The beam gives way when it is strained too much.

In a rectangular section the strain will not be the same on each side unless the modulus of elasticity is the same, but the stress may be; a beam may give way first on the side which is strained the least if its limit of elasticity is less. John B. Mayo.

### The Fellows Who Make Drawings and How They Make Them.

*Editor American Machinist:*

I see that my incidental remarks about the drawing-room artist have evoked some comment, although I did not intend any such effect, and as the drawing practice of

any shop is a mighty serious factor in the cost of product, no matter how lightly the subject is handled here by myself or others. I feel that it is far from a waste of your space to come back once more to the old vexed question of what a drawing shall be, how it shall be made, what legends, if any, it shall bear, and—burning question of all—who shall make the drawing?

Naturally, the reply to this would be that the drawing shall be made by the draftsman, same as the shoemaker is the best man to make shoes, and nailmaker is the best man to make nails. Let us look at this question.

The first draftsmen or drawing makers were the machinists or "white smiths" and millwrights. I have seen some drawings so made a hundred years ago, excellent work, every detail shown, and all the work of some one thoroughly skilled in the art.

To-day in our American drawing rooms we have some of the same kind of men; the draftsmen call them "machinist" draftsmen; they take off their coats, roll up their sleeves above their elbows, and have a wad of clean waste on the drawing board; they punch the paper full of holes clear through, and they don't join and thicken their lines to perfection; they want good, strong leads in their pencils because their fingers are slow to forget the hard mark of the scriber on steel; the fibers of waste clog their pens when they come to inking in, and their drawings are quite likely to have a general "mussy" appearance; but the machinist draftsman's drawings are also very likely to have the metal well distributed, and are sure to have such shapes of pieces as can be readily held, clamped and chucked for finishing; there is always room for wrenches to turn bolts, and holes have metal all round them, and the whole job is in shape to be built in a machine shop readily, and all difficult sizes fit some lathe or planer or boring mill, or other suitable tool in the shop, because as the machinist draftsman thinks out the shape of a piece, he thinks first of all how that piece is going to be finished, and he turns it over in his mind until he knows just how every cut is to be made. His patternmaking and molding are quite likely to be cheap and easy also, and, take it all round, it really seems as if the draftsman needed to be a good journeyman mechanic to start with. Maybe he does, maybe he doesn't. It depends a good deal on how much head he has, and how much of that head the shop wants him to use. He can worry the chief draftsman nearly to death with well-founded objections to al most any design, and he is not prevalent in large drawing rooms.

Then there is the "imported continental draftsman" of all grades, from the six-dollar-a-week-tracer, who doesn't speak English, to the high grade university graduate, who speaks three or four languages, and can be relied upon to make a creditable showing in anything except special tools; all of these imported fellows make nice looking drawings, and a great many of them do excellent work, which is all conservative—according to rule, and correctly detailed so it will go together, and is seldom brilliantly original, and *never*, so far as I have seen, *handles* well. I don't know why it is, but no other nation seems to have the ingrained Yankee laziness, which makes our tools handle so much better than any other tools. We hate to do one ounce of needless work, and if things don't handle easily we keep at them until they *do handle* easily. The imported man is contented if a good, strong man *can* handle his work; we want ours to handle with one finger, and not hard work at that.

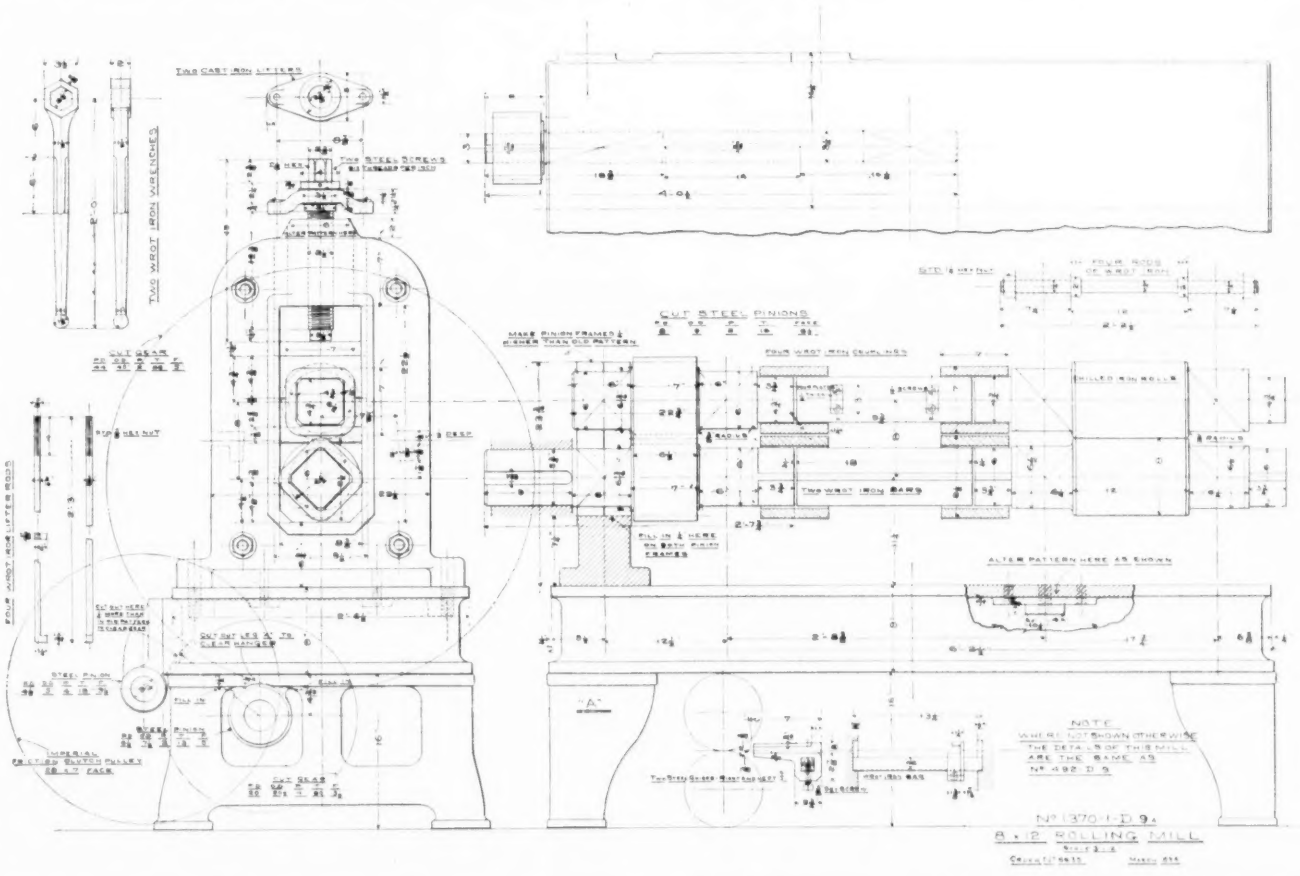
Then we have the bright "Tech" who figures things out, and isn't a little bit of a machinist, and is in a state of chronic surprise because his newest books are about five years behind current practice. He puts in little things where big ones would be better and cheaper, and occasionally trips up the chief by putting things really right which have been wrong so long as to pass unquestioned until the youthful doubter applied the rules to them. A good, bright, ambitious, young, inexperienced "Tech" in an old established drawing room is about like a pet terrier left alone in a parlor. You are sure to find the stuffing pulled out of some long cherished object when you look up the product of his industry during your absence. The "Tech" may make some queer things at first, but after awhile he begins to learn that "whatever *is* is right," no matter how wrong it is, and to disregard his books, and finds out that machines are built in machine shops, and then when he finally falls over himself, his ability to think and deduce conclusions from widely differing related facts, makes him useful.

Back of all these stands the man of the cash box, who has the wide, general judgment of use; the man who ignores all the little questions, and looks for wants and for means to fill those wants and make an honest dollar in so doing, and between the business manager and the draftsman stands the chief of the drawing room, who may be a petty crank and pull the whole place into his own narrow, crooked, personal way, and may stay a good while in a place, and make money for the shop in spite of his narrowness. The chief must be conservative; he must be safe, he must have precedent, he must not advocate novelties; he lets others lead, and avoids the responsibility of failure; he has a "system" for the inside of the drawing room, which may be good or may be bad, and *must* be followed.

In one big shop it is a fixed rule that no "construction drawing" shall have the sizes figured on it. In that shop there is a constant agonizing fear of detail mistakes; a weary going over of long lines of measurements to find out whether the correct figure is an even sixteenth or a thirty-second over or under; and there are lots of errors made which are distinctly attributable to this one silly rule, which was adopted to have the "picture" of the machine without the cloud of defacing figures needful to give the principal dimensions. Other drawing rooms discountenance any writing on a drawing; others again, where the chiefs are practical "old timers," note everything in plain terms on the drawing, so that the sheet gives all needed information to everybody. In one shop the patternmaker's drawings have only finished surface measurements figured, while others, correctly, it seems to me, assume that the patternmaker is the very man who wants to know all about a machine, and give him the regular machine drawings to work from.

Undoubtedly, one of the most difficult things to do is to make a "special" from a "regular" machine with little work and great certainty of avoiding mistakes. Herewith is a drawing from a large shop in the center of American small manufacturing, which appears to me to be a shining example of such a drawing; it is also the very latest practice for a small shop rolling mill. It was made at the Waterbury Farrel Foundry, under the superintendence of Mr. Geo. B. Lamb, with Mr. A. C. Campbell as chief draftsman. I do not think a more instructive exhibit for "Draftsman vs. Shop" could be furnished. With such drawings the chances of mistakes seem small. This drawing is in broad opposition to the "no writing" system. It is, in fact, very largely dependent on its text. Is it right, or is it wrong? It seems to me to be right, from every point of view. The question reduced to its lowest terms, is simply this: "In what language shall the idea of the draftsman be conveyed to the patternmaker, the molder, the blacksmith and the machinist?" Shall that language be wholly in the arbitrary symbols of the "geometric projection" drawing and Arabic numerals, or shall the geometric lines, which convey no ideas, whatever, to the uninitiated, and may be made to read one thing or another, according as a certain line is full or dotted, or omitted altogether, be supplemented and illuminated by such words of every-day English as shall fully apprise the mechanic, for whose information they are made, on all doubtful points? Shall the use of words be carried so far that the drawing would be unintelligible without them, or shall the drawing be so full and elaborate as to make written words a redundant absurdity? To me it seems that the present example of little drawing and perspicuous text is the cheap way for the drawing room, and that *in* the shop it is surely the

Easy Way.




We old gray heads who have come up through the livery of blue denims and machine oil and smutty noses and black hands, may turn up the corners of our grizzled mustachios at the "Tech's" collars and cuffs and patent leather shoes and the flower in his button hole, but I guess he has come to stay.

Entirely different from the continental importations are the sound, solid, English and Scotch draftsmen who have a thoroughness of practice and a fixedness of method which makes them extremely certain and reliable in detail, and generally sure to avoid discreditable results; and the quick, imaginative, often right and often wrong, Irish, and the bold work of the Swedes and Norwegians who are always full of advanced ideas, and have the adventurous Viking desire to sail new seas, and far and fast they go, too, as did the brilliantly unsuccessful Ericsson.

Then we have our own American draftsmen—men who can really think, too, same as the "Techs" can, and who never look at a book; who take a subject and look up the art, and very likely ignore all precedent, and bring out a new and surprisingly delightful creation that makes the beholder say, "How easy," and the expert wonder he never thought of it himself.

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James Canfield, 22 years of age, while standing in front of the Brooklyn *Citizen*, on which he is employed as a reporter, was suddenly stricken with blindness. Several trolley cars were passing at the time, and simultaneously there were two or three brilliant electric flashes. Young Canfield seemed to be suddenly shocked and, exclaiming, "Oh, my eyes!" reeled back and fell in the arms of a companion. Finding that his sight failed to return, his friends led him to the eye and ear infirmary in Livingston street. The doctors could afford no relief, and the young man was removed to his home. Since then his sight has been fully restored.

---

Graphite as a lubricant has been slowly coming to the front for a good many years. Since the early days of the American Machinist there have not been wanting those who have written in its favor. It appears to have, not only the quality of making surfaces slip easily by and over one another, but appears to fill up holes, as it were, making a rather solid surface when no surface exists. When a mechanic desires to judge of the quality of a lubricant there seems to be nothing so natural as to lubricate the ball of the thumb and the forefinger and then rub them together. This may not be scientific, but he gets very good results from his conclusions, and is never likely to give up the practice. One reason for this is probably in the fact that a great deal of the unclassified education of a mechanic has to do with the thumb and forefinger. He transfers sizes and does a thousand things from their sense of touch. Now, if you take a pinch of graphite between these members you will very readily see how easily they slip one over the other, even under considerable pressure, and that to the mechanic means absence of friction, and this has a good deal to do with the growing favor with which graphite is received as a lubricant.

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It is pretty safe for those who are looking after means of reducing friction in machinery to watch the means bicycle manufacturers are taking to that end. The steam engine never grumbles, but when a man has to "kick it out" the case is different.

AMERICAN MACHINIST

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NEW YORK, APRIL 5, 1894.

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## To Beat the Steam Engine.

We have received from a Kentucky friend a newspaper clipping which, along with an alleged picture of the inventor, contains a rather general statement of what the latter proposes to do in the way of annihilating the steam engine. The inventor referred to is a physician, but instead of inventing something to improve the human frame he wanders, as is generally the case, in strange fields. Compressed air, he thinks, is what is to drive the coming motor. Of course, the air must be first compressed by some kind of a motor, just what kind is not made clear. The gist of the whole matter seems to lie in the wonderful economy with which the compressed air is to be used. No one has ever been able to get all the work out of the air that was expended in its economical compression. But the way this is accomplished is told in the following extract, the air being contained in a cylinder "about six inches diameter and six feet long":

In the new motor a radical departure has been made from the old principle of construction. The cylinder, piston and crank of the old engine are done away with, and the power is applied directly to the shaft in a manner that secures ten times the power from a given unit of energy utilized. The engine is described as a mechanical paradox. There are a number of wheels revolving in different directions, wheels within wheels, and wheels revolving around other wheels, and changing the position of their axles every instant, yet all producing motion in one direction.

The seeming paradox is said to be accomplished by a peculiar co-ordinate movement discovered and patented by the inventor. It is from the study of this heretofore unconsidered movement that the invention has been developed. Dr. Williams is so certain that he has solved the problem of a better kind of energy that he says, "the days of steam as a motive power are numbered."

It is a question whether such kind of nonsense does any serious harm. It may lead to some foolish investment of capital, but, of course, will not deceive an engineer. If it was more the practice in this country for those with money to invest in engineering projects to submit the matter to an engineer, paying him for his services, no harm would come from such talk. But this is not the practice, and here is where harm comes. The matter of "wheels within wheels" and "wheels revolving around other wheels," etc., would be all-sufficient for the engineer.

We expect the doctor is quite honest in his opinions and intentions, but would recommend to him the study of some elementary work on physics.

## "The Personnel of the Navy."

A story which throws a very interesting side light on the condition of affairs aboard one of our new naval vessels, comes from California, where a petty officer belonging to the "Yorktown" is quoted as saying: "It is the first time in my experience of 14 years in the navy that I ever knew men to be refused money and liberty on returning from a foreign station. On the 'Yorktown' there are at least 100 men in the first class or better, with anything from $100 to $300 coming to them. They have had a long siege of duty at sea and on an unpleasant station, and in a few weeks will start for another long cruise in the out-of-the-way waters of Behring Sea. Their ship is in dock [at Mare Island] and there is no work or duty to interfere with their being granted a day or two each down here. All the boys are anxious to see the Midwinter Fair, but that seems to be out of the question."

It is further stated that "the captain probably knows what he is about in the exercise of his paternal relation towards the men, for he puts his foot down on all kinds of improvidence. No matter how much money a man has coming to him, $5 is the limit he is allowed to draw when going ashore. If a man wants to send money home, a check from the Bank of Vallejo on some Eastern concern is given him, and he is compelled to seal it up in the presence of an officer, who gives the letter to the 'mailman' to post."

It is just possible that the captain does know what he is about in this matter, but if this be the true state of affairs we wonder if the people of the United States know what they are about when they sustain the expenditure of money for first cost and maintenance of war vessels manned by men who are no better capable of taking care of themselves and their own affairs than is indicated by this report.

It is morally certain, at any rate, that the glorious history of the American Navy was not made by vessels manned by men of that stamp, and it seems to us that if our new vessels are manned by sailors who cannot be trusted with the spending of their own money and with the management of their own private affairs generally, there had better be a new set of men, and the quicker the better.

We believe naval victories will be won in the future as they have been in the past, *i. e.*, by the men who approach nearest to being real men, good and self-respecting citizens, while those who will lose future naval battles will be those who are simply human animals that must be looked after, and their thinking done for them. It may be as important to look after the personnel of that part of the naval force that never treads the quarter-deck as that which does tread it.

## Safe Burglary.

The articles that have appeared in the American Machinist during the past few months on safe burglary have attracted wide attention not only from the daily press, but from detective agencies and the manufacturers of safes. These articles will help, beyond doubt, to improve the manufacture of safes, and will serve a useful purpose, as well as serve their other purpose of interesting the general reader. The best way to make safes safe, as has been our opinion all along in the publication of these articles, is to show just how little of the quality of safety they really possess. The expert safe burglar is a mechanic of a high order, whose talents have been perverted to a bad purpose. He understands the mechanical powers, and he understands the modern use of the high explosives. If safes are to be made safe against his arts, he must be met, in their construction, by the arts of the mechanic, who is equally expert, or more so. Hobbs showed the world, some years ago, how to pick locks, and how to make locks that could not be picked. The modern safe burglar does not depend upon his ability to pick locks. That is an old-fashioned way of entering safes. Modern science has produced locks the picking of which is too troublesome a matter. But modern science has also developed a use of explosives that can be met only by the providing of means for preventing their introduction into places where they shall do the harm that it is desirable to avoid, or to prevent their undesirable effect when so introduced. This we have no doubt will be accomplished when there is sufficient attention called to the matter. That a good deal of attention is being called to the matter we have abundant evidence.

## Samuel L. Moore.

The head of the firm of Samuel L. Moore & Sons Co. died at his home in Elizabeth, N. J., on the 16th inst., of pneumonia. Mr. Moore was a few months over 90 years of age at the time of his death, and had not for some time been actively engaged in business, though it was his habit to still visit the shops frequently up to the time of his last illness. He was the first master mechanic of the Central Railroad of New Jersey, and was in charge of the Elizabethport shops. He afterward went into the foundry business and conducted a large plant for some years, afterwards building the Crescent Iron Works, which, with the help of his three sons, he has carried on. All who knew Mr. Moore felt a high regard for him, and he was a very highly esteemed citizen of the town in which he lived. He was quiet and unassuming, yet of great ability and sterling worth.

Again there are rumors of a sewing machine combination which, it is said, will include the White, Standard, Davis and Domestic Companies, with as many others, of course, as can be induced to enter it.

The fact that the Domestic Company is, and for some time past has been, in the hands of a receiver, is said to interfere somewhat with the consummation of the plan, but it is hoped to complete the arrangement.

From the manufacturer's standpoint the sewing machine business has undoubtedly been in a bad way for some time, but the chief reason for this seems to be that there are too many agents handling them, who must live and pay expenses, even though they sell but one machine a week.

The manufacturer's price is certainly low enough, and, in fact, the inability of the Domestic Company to pay its liabilities would indicate upon the face of it that prices were too low, and a combination which should confine its efforts to raising this price without increasing the price paid by the user of the machine might be successful if it could include three or four large manufacturers not mentioned above.

As the sewing machine business has been carried on it has cost an unreasonable proportion of the retail price to sell the machines, and it ought to be possible to sell them by a better method than that which has prevailed—a method by which the men who make sewing machines can get more money for doing it and those who sell them, less per machine.

If an organization of mechanical engineers had, previous to the award of the last contract for gun lathes for Watervliet Arsenal, insisted upon it that government-designed lathes were a disgrace to the country, and that the new lathes should be constructed upon plans made by members of the organization; and if the president of the organization, in corresponding with the Secretary of War about the matter, had used such language as made it absolutely necessary for the department to abruptly close the correspondence, then we should have a parallel case to that of the American Institute of Architects on the one hand, and the U. S. Treasury Department on the other, with respect to the architecture of U. S. public buildings.

It might, of course, be true that gun lathes designed by the War Department were very inferior, and even disgraceful; but the president of any sublimated trade union who should undertake in a sarcastic letter to tell a cabinet officer what his duties were, might reasonably expect to get the worst of it.

There are those, however, who had somewhat to do with the Chicago Fair, that are not at all surprised at the attitude assumed by the late Director of Works, in this matter, audacious as it may seem.

It is announced in Washington dispatches that the Secretary of the Navy is about to invite inventors of machine guns to submit their guns for a test by Navy Department experts. It is possible, of course, that this invitation will bring out something new in the way of a machine gun, but it is more likely that some one of the already well-known guns will be adopted. Though we do not understand that the guns submitted for trial must be 6 millimeter caliber, the mechanism must be suited to that caliber, which indicates that the adopted gun will fire a bullet of that size; which is very nearly ¼ inch. A jacketed bullet will be used and will be fired with smokeless powder at a muzzle velocity of at least 1,950 feet per second. It is understood that not less than seventy-five guns will be purchased.

Those who have been paying any attention to affairs abroad know that our recent and present depression in trade and industrial activity is contemporaneous with similar and, in some cases, even worse "hard times" in foreign countries; and it is significant that now as our own industries are be-

ginning to revive our English exchanges are publishing accounts of the revival of industries there. *The Engineer* of London, in its issue of March 16th, has an article which gives details of the improved condition of industries in England and Scotland, and says that, "Prospects for the iron and steel masters of Scotland and the northern counties of England, and for the marine engineering and some other of the engineering centers are better at the present time than they have been for many months."

## Literary Notes.

THE "PRACTICAL ENGINEER" POCKET-BOOK AND DIARY, 1894. Edited by W. H. Fowler, Wh. Sc.; M. Inst. M. E., Assoc. M. Inst. C. E.

Engineers and artisans will find this little pocket book and diary to be a very useful and handy one. The rules relate mostly to steam engineering, gas engines, rope and belt driving, speed of cutting tools, tables and information of a general character. The book seems to be carefully edited and compiled, and we believe it to be reliable, although we notice a slight error in the notes on boilers. It says that "a standard of 30 pounds of water per hour, evaporated at 70 pounds pressure from water at 212 degrees, was adopted by the judges at the Centennial Exhibition in America a few years ago, and this standard is now coming into general use." The standard adopted at the Centennial Exhibition is 30 pounds of water per hour, evaporated at 70 pounds pressure from 100 degrees (not 212) for each horse-power. The book is published by the Technical Publishing Company, Limited, 6 Victoria Station Approach, Manchester, England. Price one shilling. Roan, gilt edges, with pocket and elastic band, 1s. 6d. Net, post free.

NOTES ON HEAT AND STEAM, by Charles H. Benjamin, Case School of Applied Science, Cleveland, O.

Students and those who have frequently to deal with problems relating to the measurement of heat, laws governing the relations between heat and mechanical energy, steam, expansion curves and kindred subjects, will find it to their advantage to keep this pamphlet of 46 pages within reach. It is divided into five chapters treating respectively on the measurement of heat; combustion and fuel, including tables of the evaporative power of fuel, and temperature of fire; chimneys, including a table of the heights of chimneys for a given amount of coal burned per square foot of grate surface per hour; thermo dynamics, including tables of properties of saturated steam, and hyperbolic logarithms; steam, including a table of the consumption of coal and water per I. H. P. per hour.

The whole matter is given in a condensed form with such rules as are liable to be frequently used. It is a valuable work of reference and will be appreciated by any one who is interested in heat and steam. The name of the publisher and price of the book are not given, but the book can probably be obtained by writing to the author.

## Questions and Answers.

*Questions of general interest relating to subjects discussed in our columns will receive attention in this department. The writer's name and address should always accompany the question. Neither correct initials nor location will be published when there is a request to that effect. If questions are enclosed with a business communication, they should be written on a separate sheet.*

If the party who signs himself A. A, Detroit, Mich., will observe the request at the head of this department and send his name and correct post office address we will answer his question.

(163) T. W., Brooklyn, N. Y., writes: Please give me information as to whether there is a practical school of engineering in the neighborhood, as I am desirous of studying for the profession. *A.*—Apply at the Pratt Institute in your city.

(164) A. H. R., Horton, Kan., writes: Please inform me how to take the kinks out of a buzz or circular saw? *A.*—We cannot do it. This job can be satisfactorily done only by a saw hammerer. In reply to your other question: Any transposition of unequal sized gears, other than idlers, will, of course, change the velocity ratio.

(165) D. R. W., Franklyn, N. H., asks: What kind of steel is the very best in the world for razors? *A.*—We do not know, and we doubt if anybody does know. Probably there are several brands of the highest grade steel, both foreign and American, that are so nearly equal that it would be exceedingly difficult to choose between them.

(166) E. E. M., ——, Conn., writes: Given two gears of equal diameter, one stationary and the other revolving around the stationary gear. How many times will the revolving gear turn on its axis in making one revolution around the fixed gear? *A.*—The revolving gear will make one turn around its axis during one revolution around the fixed gear.

(167) L. E. A., Plymouth, Mass., writes: Please inform me where I can get a book treating on tempering tools. *A.*—"Practical Blacksmithing," Vol. IV, edited by M. T. Richardson, devotes a few pages to this subject. You can obtain it by addressing M. T. Richardson, New York. You will probably find more information on tempering tools in our columns than in any book.

(168) C. W. O., Newark, N. J., writes: Please inform me through your columns the greatest number of revolutions per minute made by any diamond cutter, disk or emery wheel in this country or abroad. *A.*—There are no records kept of the highest speeds of emery wheels, etc., as they are useless. Speeds have been so high that emery wheels have burst, and if the tensile strength of the material is known, there will be no difficulty in computing the speed at which these wheels burst. It is dangerous practice to determine the speeds by records only; they should be determined by careful computations whenever it is possible to do so, otherwise adopt such safe speeds as your own experience dictates, or such as the manufacturers of the wheels will guarantee.

(169) Engineer, Denver, Col., asks: At an altitude of 5 200 feet above the sea level is the vacuum in a condensing engine as effective as at the sea level? *A.*—Yes. 2. How many inches should the vacuum gauge show when the engine is in good working order at the above altitude? *A.*—About 20 inches. 3. Is a given steam pressure as shown by the steam gauge as effective at the altitude as at the sea level? *A.*—The absolute steam pressure at any place is equal to the pressure shown by the steam gauge plus the atmospheric pressure. Since the atmospheric pressure decreases with an increase of altitude the absolute pressure will be greatest at the sea level, and, consequently the same steam pressure as indicated by the steam gauge will be more effective at sea level than at the given altitude.

(170) E. M. H., Chicago, Ill., asks: Can I obtain a good education in engineering by taking a course in the Correspondence School of Mechanics? *A.*—We believe you can; much depends on your own exertions and ability. 2. Is its diploma accepted by employers as evidence of the competency of the bearer? *A.*—Employers do not determine the competency of engineers by their diplomas, but by the work they can do. 3. Would it be advisable for me to take a course without any previous knowledge of machinery? *A.*—Yes. 4. Would it be necessary for me to serve an apprenticeship in a machine shop while taking a course in the correspondence school, to become a competent mechanical engineer? *A.*—In our opinion it is necessary for all mechanical engineers to have a good practical knowledge, and this can best be obtained by working in a machine shop. 5. Is there any shop in or near Chicago where I can obtain a general knowledge of machine shop practice? *A.*—Yes, a number of them; small general jobbing shops are as good, if not better, than the larger shops for obtaining a general knowledge of machine shop practice.

(171) F. W. C., Springfield, Mass., asks: What is the difference in the driving capacity of a 4 inch belt on a 6 inch pulley; in one case the arc of contact is 180 degrees, in the other case it is 90 degrees? Equal tension in both cases. *A.*—The horse-power which a single belt will transmit, the arc of contact being 180 degrees, is found by the following formula:

$$H = \frac{D \times R \times W}{2{,}750},$$

in which $D$ = diameter of the pulley in inches, $R$ = revolutions per minute, $W$ = width of belt in inches and $H$ = horse-power. The horse-power which a double belt will transmit, the arc of contact being 180 degrees, is found as follows:

$$H = \frac{D \times R \times W}{1{,}925}.$$

For single belts with an arc of contact of 90 degrees, we have:

$$H = \frac{D \times R \times W}{6{,}080},$$

and for double belts when the arc of contact is 90 degrees, we have:

$$H = \frac{D \times R \times W}{4{,}250}.$$

In all these formulas the symbols denote the same quantities as stated in connection with the first one. From the above it will be seen that the driving capacity of belts with an arc of contact of 180 degrees is more than double that of the same belts running under the same conditions with an arc of contact of 90 degrees.

(172) M. R., Philadelphia, Pa., writes: Please inform me what formula you would use for computing the diameter and lift for ordinary clack valves in plunger pumps of the marine type for feed and bilge pumps. Say, for a 3-inch plunger pump, the velocity of the plunger being 250 feet per minute. *A.*—First find the diameter of the feed pipe and then add not less than 20 per cent. of the area of the feed pipe for the seating area of the valve, the corresponding diameter will be the diameter of the valve. For finding the diameter of the feed-pipe divide the diameter of the feed-pump plunger by 23, and multiply the quotient by the square root of the velocity in feet per minute of the plunger, the result will be the diameter of feed-pipe. In symbols we have

$$D = \frac{d}{23} \times \sqrt{s}$$

in which $D$ = diameter of the feed-pipe, $d$ = diameter of the feed-pump plunger, and $s$ = its velocity in feet per minute. Applying this rule to your example we have

$$D = \frac{3}{20} \times \sqrt{250} = 2.37, \text{ say, } 2\tfrac{3}{8} \text{ inches.}$$

The corresponding area is 4.43 square inches; adding 20 per cent. we have $4.43 \times 1.20 = 5.316$ square inches, and the diameter corresponding to an area 5.316 square inches is $2\frac{3}{8}$ very nearly, which is the diameter of the valve. A valve a little larger in diameter will reduce the wear. The valve should swing through an angle of about 60 degrees. 2. Would you make the valves different for bilge pumps which work against a head of 6 feet, the feed-pump working against a pressure of, say, 100 pounds? *A.*—We should make no change in the valves.

(173) A. G. J., Ottawa, Ont., writes: By means of a screw I require to move a weight of 30,000 pounds backwards and forwards, movement of weight about 2 feet, rate of movement about 5 feet per minute. Please give me information as to the best shape, pitch, and diameter of screw for this, and how to determine same. Please also name a publication treating on screws for such a purpose. *A.*—Unwin's "Elements of Machine Design," Part I, treats the matter somewhat, but literature upon the subject is scarce. Unwin says that where screws are used for transmission the axial pressure should not exceed 900 to 1,200 $d\,l$ for square threads, $d$ being the outside diameter of the screw, and $l$ the length of the nut in inches. If, now, the screw has to lift 30,000 pounds, and neglecting the pressure due to acceleration, the axial pressure will be equal to the weight lifted, and assuming that this pressure should not exceed 1,000 $d\,l$, we have

$$30{,}000 = 1{,}000\,d\,l. \qquad (1)$$

If we further assume that the length of the nut is to be twice the diameter of the screw, then formula (1) takes the form

$$30{,}000 = 1{,}000 \times 2\,d^2, \qquad (2)$$

from which we get

$$\frac{30{,}000}{2 \times 1{,}000} = d^2, \qquad (3)$$

which gives us practically 4 inches for the outside diameter of the screw. The above is based on the following proportions of thread given by Unwin: Let $p$ = pitch, and $d$ the outside diameter of the screw, then

$$p = .16\,d + .08.$$

This gives a pitch of .72 inch, or nearly 1.4 threads per inch. The diameter $d_1$ at the bottom of the thread should be equal to

$$d_1 = .85\,d - .075 = 3.325 \text{ inches.}$$

If the weight has to be moved in a horizontal direction, the diameter of the screw and pitch will, of course, be much reduced.

(174) J. P. S., New Orleans, La., writes: Please give me some information that will help me out of a lot of trouble. I am an engineer in a rice mill. We have recently put in an engine to drive our brush, but we cannot get the speed out of the engine; cylinder, 12 by 16 inches, and rated at 50 horse-power. It should run 150 revolutions per minute. We have made several changes in pulleys on our engine and line shaft, but I cannot say that we gained anything. We have at present a 48 inch pulley on the engine, and a 30 inch pulley on the line shaft. On the end of the line shaft we have a bevel gear with 53 teeth, and on the spindle of brush another bevel gear with 34 teeth. I would like to know if, by changing the 53-teeth wheel to the spindle, and the 34-teeth wheel to the line shaft, I can gain any power, and make the brush run any easier? The brush at present makes 300 revolutions per minute, and the engine 130. In order to do good work, the brush should make 380 revolutions. Any information you can give me will be appreciated. *A.*—If the engine makes 130 revolutions per minute, then, with the given size of pulleys and gears, the brush should make 324 revolutions. Changing the gears as you propose to do will increase the speed of the engine, and enable it to develop more power, provided your steam plant can furnish a sufficient amount of steam. This change of gears, however, will make the piston speed too great for the required speed of brush; we should, therefore, not advise you to make this change. You will obtain better results by increasing the diameter of the pulley on the line shaft, say, to 36 inches; we cannot give the exact figure without knowing more of the work the engine has to do. Do not omit changing the governor of the engine to suit the increase of speed; it is possible that, in making the previous changes, you have paid no attention to the governor, and this may be the cause of your present trouble. From the meager data you have given us, it is impossible to decide whether the engine is large enough to do the work or not.


## Business Specials

*Transient Advertisements 50 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue.*

Grant's Gears, Lex'n, Mass., & Phila, Pa. See p. 12.

Forming Lathes, Mer. Mach. Tool Co., Meriden, Ct.

Milling Machs. Kempsmith M. T. Co., Mill., Wis.

Turret Drills, 6 spindles. A. D. Quint, Hartford, Ct.

Chucks, the Nat'l, est'd 1882. 39 Cortlandt St., N. Y.

Speed Gage McLauthlin & Co., Fulton St., Boston.

Pattern and Brand Letters. A variety of sizes and styles. Heber Wells, 8 Spruce St., New York.

Davis Key Seating Machines kept in stock by Manning, Maxwell & Moore, 111 Liberty St, N. Y.

Selden Packing for stuffing box, with or without rubber core. Randolph Brandt, 38 Cortlandt St., N.Y.

Pulley lathes, most efficient offered. The Lodge & Shipley Machine Tool Co., Cincinnati, O.

Steam Pressure Regulators, Reducing Valves, Safety Checks. Foster Engineer'g Co., Newark, N.J.

M. E. Howard, Indianapolis, Ind. Specialty, 4 and 8 H. P. engines in stock, write for price.

Engine Castings, 1 to 6 Horse-power Vertical. Humphrey's Foundry, Bellefontaine, O.

American Packing Rings make pistons steam tight. Are simple, durable and inexpensive; write for circular. J. H. Dunbar, Youngstown, O.

Guild & Garrison, Brooklyn, N. Y., manufacture steam pumps, vacuum pumps, vacuum apparatus, air pumps, acid blowers, filter press pumps, etc.

Improved Duplex and Special Gear Cutters in stock and to order; Gear and Milling Cutters of all descriptions. R. M. Clough, Tolland, Conn.

"Pumping Machinery." New book, 450 pp. 8vo, 270 Eng. Prospectus free. W. M. Barr, 3223 Powelton avenue, Philadelphia, Pa.

Pocket-book of alphabets, post free, 20 cents. List free. Spon & Chamberlain, 12 Cortlandt Street, New York.

New Jersey Art Metal Co., Passaic, N. J., finest thin and ornamental castings in brass, bronze, aluminum, etc.; machinery name plates in brass and aluminum.

Grinders' Supplies—Emery, Emery Wheels, Grinders, Knife Powders and Sharpeners, Paste & Liquid Polish, Whetstones. The Tanite Co. New York, N. Y.; Cincinnati, O., & Stroudsburg, Pa.

"Binders" for the American Machinist. Two styles, the "Common Sense," as heretofore sold by us and mailed to any address at $1.00 each, and the "New Handy," mailed at 50c. each. The former has stiff board covers, while the latter has flexible covers with full page opening flat. Either will hold the entire 52 issues of any volume. American Machinist Publishing Co., 203 Broadway, New York.

"Indicator Practice and Steam Engine Economy." By F. F. Hemenway. Contains plain directions for using the indicator and making all required calculations from the diagram, also the principles of economy in operating steam engines and current practice in testing engines and boilers. Price, $2 post paid. Published by John Wiley & Sons, 53 East Tenth street, New York.


## A Remarkable Wind-mill.

A wind-mill of somewhat remarkable proportions and placed upon a tower which is said to be the highest ever erected for that purpose, has been put up by Mr. A. J. Corcoran upon the property of Mr. Prescott Hall Butler, at St. James, L. I. Several wind-mills of equal power had been previously erected by Mr. Corcoran, but upon towers not exceeding 125 feet high, while the present tower is 190 feet high. This was done because the spring from which it was desired to pump water was upon the beach and at times covered by the tide, the ground rising rapidly from this point, so that it was necessary to raise the wheel to a very considerable height in order that it might be above all obstructions within 1,000 feet from it. Twenty barrels of con-

crete, 40 barrels of cement, 20,000 bricks, 42,000 feet of Georgia pine and more than six tons of bolts, washers and iron plates were used in its construction. The mill that surmounts this tower is 22½ feet in diameter and pumps water through 6,000 feet of pipe to a height of 223 feet. It delivers water to a reservoir of a capacity for 65,000 gallons, which it has filled in two days.

## Making a Fusee or Derrick Barrel.

By Joseph Horner.

The making and molding of the fusee barrel, Fig. 1, by which the jib of a derrick crane is elevated and lowered, will afford an interesting study in pattern work, core making and molding. The pattern is made in loam, struck against the edge of a flat board, and the ratchet is cast on the large end of the barrel.

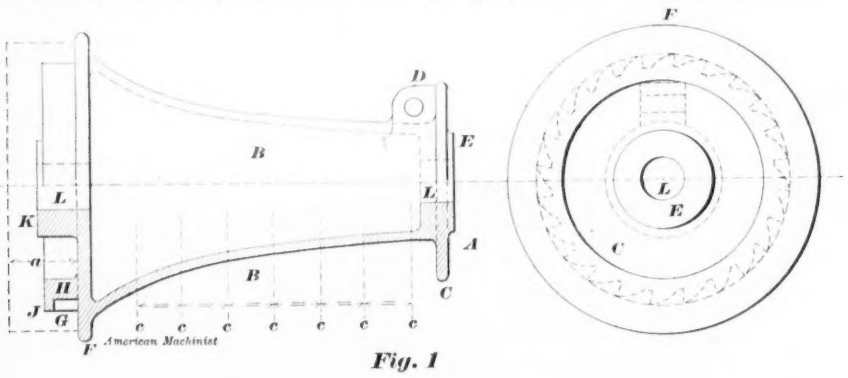


Fig. 1

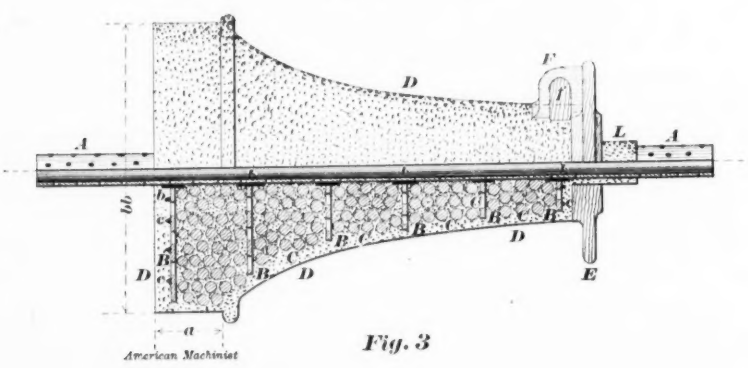


Fig. 3

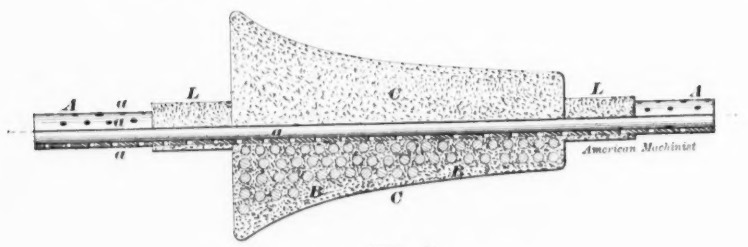


Fig. 5

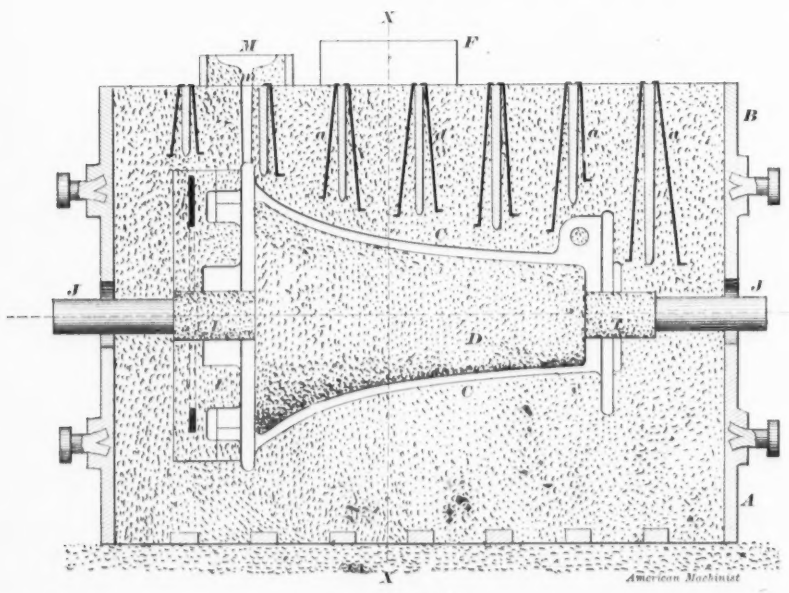


Fig. 8

Fig. 1 shows the barrel in half longitudinal outline, half longitudinal section, and in end view; this view being taken against the small end *A*; *B* is the body of the barrel, upon which the chain is coiled and which is set out carefully, giving certain fixed diameters on the dotted lines *c* at short intervals, in order to produce regular derricking. *C* is the small flange, *D* the lug for the attachment of the eyebolt of the chain, *E* a thin boss or facing which runs against the shaft bearing on that side, *F* the large flange, *G* the ratchet wheel by which the chain is prevented from running out—a pawl or click dropping into the ratchet teeth, *H* the ring of metal behind the ratchet, *J* a shroud to strengthen the teeth, *K* a boss which runs against the shaft bearing on that side, *L L* the holes for the barrel shaft.

For obvious reasons the pattern is molded upon its side just as it appears in Fig. 1. One mold joint suffices then, whereas if molded vertically there would be two joints required, involving also a deep middle flask, with no corresponding advantage.

The pattern might be made in wood complete, or, as is more usual in these cases, in loam. Made in loam there can be no middle joint in the pattern to correspond with that in the mold, but the top flask must be lifted bodily away from the pattern, involving some considerable fracture and subsequent mending up.

Fig 2 shows the striking board used for the pattern. A comparison of this with Fig. 1 will show the relationship of the board to the casting. *a a* corresponds with the center line of the barrel, and the radii of the several sections *c* of the edge of the board are set out from that line *a a* as a center. The edge *B* strikes the curved edge *B* (compare with Fig. 1), the position of the flange *C*, in Fig. 1, is shown by the dotted lines in Fig. 2, *C*. The flange fits against a shoulder *b*, struck on the barrel pattern, and the hole in the flange is cut to the radius *l*, which is that of the print for the corresponding hole *L* in Fig. 1. At the other end the flange *F* is struck directly as a portion of the loam pattern instead of being made in wood like the flange *C*. The reason why one is made in wood and the other in loam is that *F* is a mere slight projection, and will therefore run no risk of fracture, while *C* is a thin web of considerable area, and would therefore become broken, if made in loam. At *A* there is a wide recess cut in the board of width *a*, and radius *b*. This forms the print for the ratchet core. It is shown dotted also at *a* in Fig. 1. It is brought up nearly to the edge of the flange to afford sufficient sand in the core beyond the points of the ratchet teeth, and is brought back a considerable distance from the faces of the shroud to give sufficient sand there. Beyond this point the edge of the board is cut to any radius *l*, only to clear the core bar, no print being formed there; the ratchet core which fits into the print formed by *A*, being made to carry that end of the core, as we shall see presently. The line *d* represents the end of the print at the right-hand end.

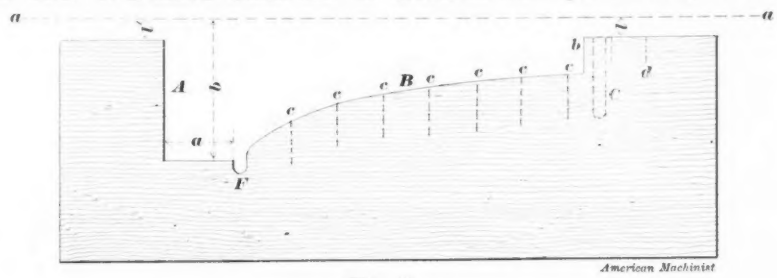


Fig. 2

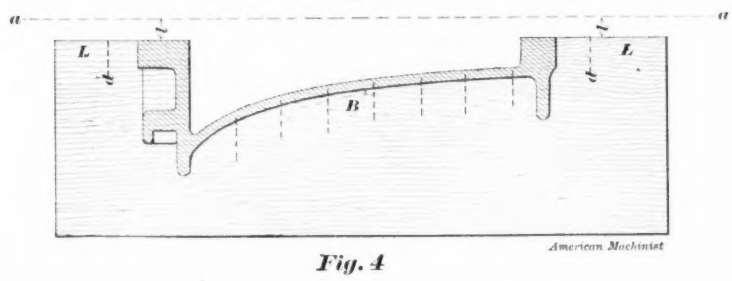


Fig. 4

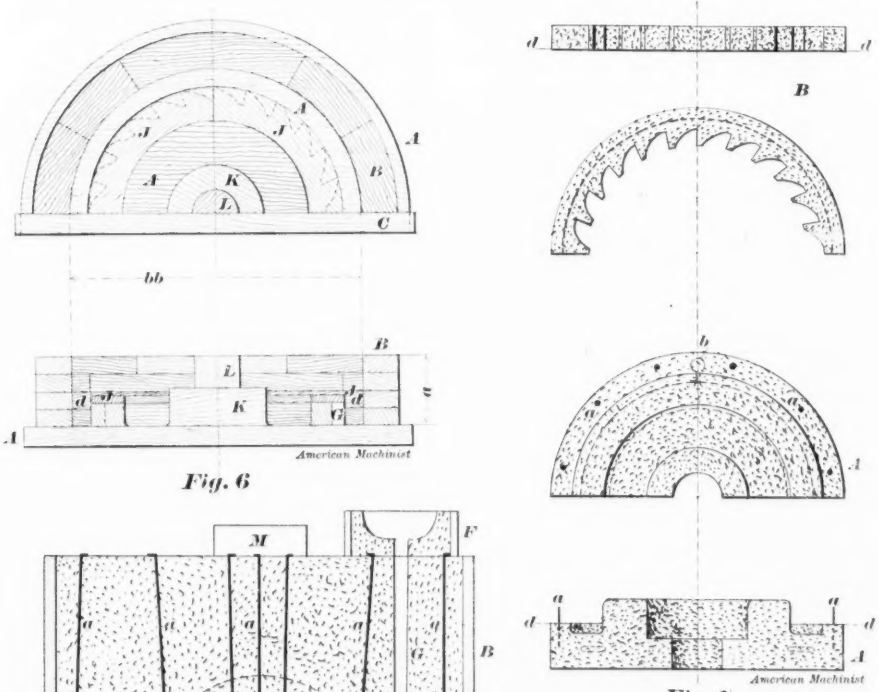


Fig. 6

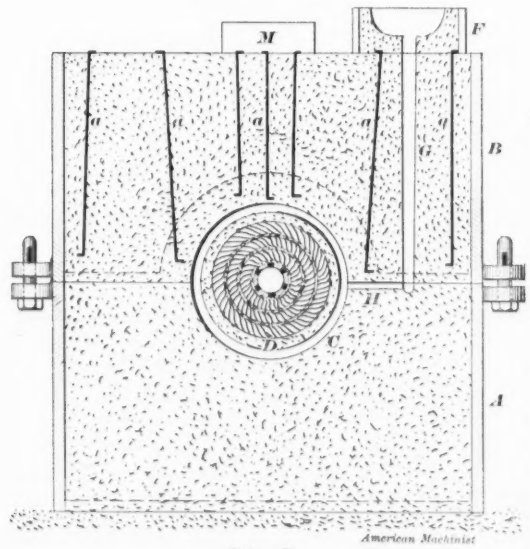


Fig. 9




Fig. 7

Fig. 3 shows the loam pattern in its various stages. First, there is a core bar, *A*, of wrought-iron pipe. It is of sufficient length to receive the pattern and core prints, to have sufficient journal bearing on the core trestles, and length beyond for a boy to turn the winch handle.

Now, a mass of loam of the size of this barrel would not stand of itself, but would sag and fall apart; so in striking up loam patterns a skeleton of cast-iron plates and hay bands is built up. The plates are shown partly in section at *B* in the figure. They are of cast iron from ¼ inch to ⅜ inch thick, cast with holes to facilitate subsequent fracture. They are secured to the bar with small iron wedges, *b*. Note the gaggers or prods *c* on the end plates. These serve to secure the loam upon the ends, which without the prods would be likely to scale off.

Between all the plates hay bands *C* are wound tightly, well bedded in layers of thin loam. A good deal of hay band is used in a large loam pattern. It is brought up within about ¾ inch or 1 inch of the finished edge of the pattern, which is then completed with loam only. The loam is well worked in amongst the bands and over them with the fingers. Before the final coat is struck the pattern is put aside for a few hours to become partly set and dried, and then the final coat of fine sifted thin loam is put on, and struck to the outline at *D*. The print for the ratchet core is of diameter *b b* and thickness *a*, corresponding with that shown dotted at the left of Fig. 1.

The end of the bar to the right, beyond the pattern proper upon which is formed the print *L*, is not wound with hay bands, because there would not be sufficient thickness for the bands beyond the bar. Fibers of hemp are wound round that portion just sufficient to hold the thin coat of loam applied around the hemp, and which without the hemp would peel off the bar. Although a core bar is used to strike the pattern

upon, of course, it is not used as a core bar, that is, the vent holes seen in the figure are not required. Finally the pattern is put into the stove to be dried.

After the pattern is dried it is taken out of the stove, put on the trestles, and smoothed over with glass paper, after which it is ready to receive its attachments, namely, the small flange *E*, and the lug *F* with its prints *f*. The loam body is painted with tar, and is then ready for molding. We will defer the consideration of this until after the making of the cores.

The striking board for the main or body core is shown in Fig. 4. The relationship of this to the casting is clear on a comparison with Fig. 1. As in Fig. 2, *a a* is the center from which all radii are set out. The thickness of metal in the barrel is shown shaded on the board. This is often done so, or else varnished black, as a guide to the molder for checking the correct thicknesses between the core and the mold by. *B* represents the edge, therefore, of the body of the casting, and the positions and dimensions of the ratchet and bosses are clearly shown by the shading. The edges *L L* are cut to the radii *l l* to correspond with the edges similarly lettered in Fig. 2, so that the cores for the end holes shall exactly fit the print impressions imparted by the pattern in Fig. 3, and the hole formed by the print *L* in the core box in Fig. 6; *d d* are the ends of the core prints corresponding with *d* in Fig. 2, and the edge of the recess *A* in the same figure.

Fig. 5 shows the core struck up. It is built upon a core bar, *A*, pierced with vent holes. Hay bands, *B*, are wound tightly round, no plates being used, and loam is worked between and over them, as already described in connection with the pattern, Fig. 3, and the final coat of loam, *C*, is struck by the board in Fig. 4. The ends *L L* fit the impression made by the core prints on the pattern, and in the ratchet core box, Fig. 6.

Fig. 6 shows the ratchet core box. It is a half-box, two half-cores made from it forming the complete ring of teeth. There is a bottom board *A*, which carries the semicircular ring *B*, of internal diameter *b b*, corresponding with the external diameter *b b* of the print *D* in Fig. 3, and of depth *a* equal to the width *a* in Fig. 3. This ring is built up in segments. If made solid, it would shrink and go out of truth. The ring of ratchet teeth *G* is made in one thickness, but in two segmental lengths, in order to avoid short grain. Its shroud *J* is also made in two lengths, and doweled upon it. The half-boss *K*, with its print *L*, is screwed to the side *C* of the box.

Now, it is impossible to make the cores from this box in one piece, because the shroud *J* could not be withdrawn from the core, if rammed entire, being entirely embedded in it. The core is, therefore, made in two portions, divided along the plane *d d*, and stuck together while green. The two cores are shown separately as rammed in Fig. 7. The cores are made in such a way that they shall be put together with no risk of becoming displaced relatively to each other. Wires, *a*, are rammed up in the bottom core *A*, which is made first; parting sand is strewn over the joint face *d*, and the top core *B* is rammed over that while still green. Then the box is turned over, the bottom *A*, front *C*, and half circle *B*, in Fig. 6, taken away, and that portion of the one which contains the ring of teeth lifted off from the other, and from the wires *a*. The way is then clear for the removal of the shroud, and the two portions of the core then dried in the stove, and afterwards stuck together, the portion *B* going back over the projecting wires.

A stout curved wire of about ¼-inch diameter is rammed in each core to stiffen it, and also to provide a means of lowering and of securing it in the mold. For the bottom of the mold the loops are in the joint face of the core, being used only for lowering it down by; for the top of the mold the loop is at *b*, being used for securing the core in the cope, so that it shall not fall out when the cope is turned over upon the drag part.

Figs. 8 and 9 illustrate the mold of this barrel, by means of which the relationship of the various sections thereof is clear. The loam pattern is molded like an ordinary pattern of wood in drag *A*, and cope *B*, the top being well liftered, *a*. In these figures *C* is the body of the barrel, molded from Fig. 3; *D* is the central core, Fig. 5, resting in the print impression *L L*, the one to the left being formed in the ratchet core *E*; *F* is the pouring basin, *G* the runner, *H* the ingate. The air from the mold comes out from the bottom of the drag, and from the top of the cope; that from the main core comes out from the ends of the core bar *J*. That from the ratchet core is brought away into the mold, and through the cope. *M* is the riser cup, the function of the riser *m* being to relieve the mold of strain at the time of pouring. The mold may be fed also here.

## Reckless Boiler Management.

We have sometimes admitted that there was rather more recklessness in the use of steam boilers in this country than elsewhere in the civilized world. In consideration of the following, which we take from *Engineering*, we are inclined to take this back. We doubt if anything, even in saw mill work, could surpass the recklessness set forth. We append the account without further comment:

BOILER EXPLOSION AT BUCKIE.

A startling illustration of the recklessness which is sometimes displayed in the purchase and working of second-hand boilers has been afforded by an explosion which occurred last December at Buckie, Scotland, and which has formed the subject of a recent formal investigation by the Board of Trade.

The explosion took place on Tuesday, December 19th, at an iron foundry owned by Messrs. William Adam & Son, and resulted in the death of the senior partner, Mr. William Adam. The boiler was a very small one of the single flued Cornish type, and was bought last August by Mr. Adam. It rent longitudinally at the back of the external shell, and also fractured through the manhole at the top and along the side of the steam dome, in addition to which the front end plate was blown completely off. The boiler was wasted by corrosion, and was also worked at a pressure greatly in excess of what it was capable of sustaining. The following are full particulars brought out at the formal investigation:

The Commissioners appointed to investigate the explosion were, Mr. Robert Lamb, advocate, Aberdeen (President), and Mr. Holland Harrison, engineer, Edinburgh. Mr. Henry Peterkin, advocate, Aberdeen, conducted the proceedings for the Board of Trade.

Mr. William Adam, junior, was the first witness, and stated that he was, up to the date of the explosion, in partnership with his father at the Seafield Foundry. He was trained as a mechanic, but had no special knowledge of boilers or their management, his duties being to look after the turning and fitting shop. When the firm commenced business they had a portable boiler and engine combined, but there was no stated person engaged to look after it. In August last his father bought the boiler which formed the subject of the present inquiry, his reason for buying it being that the portable boiler was too costly in its consumption of fuel. It was used for driving the turning lathe and boring machine, and also for foundry purposes. Knowing nothing about boilers, he trusted to his father, who professed to be quite qualified in that matter. As regarded his father's experience with boilers and engines, witness said that when his father's apprenticeship in Scotland was finished, he left for Australia, and while there he was in charge of a coffee-mill, where there were two boilers and engines. He then removed to New Zealand, where he was in two engineering shops, those of the Anchor Line Company, and Mr. Mooterie, of Nelson. He was ten years in Nelson, but what experience of boilers he had there witness did not know. The firm of William Adam & Son did not repair boilers, but some months after his father purchased the boiler which had since exploded, witness assisted in putting a patch on the back end under his father's supervision and to his orders. He never saw any leakage or indication of weakness. When his father bought the boiler from a Mr. Moore, of Glasgow, he told him the price, and said it had been tested to 100 pounds hydraulic pressure, but he had no guarantee as to its working capacity, pressure or strength. On the day of the explosion, witness stopped for dinner at 12 o'clock. There was no one in particular looking after the boiler that morning. After returning to the works, he noticed that the pressure on the gauge was 50 pounds, and soon after this the explosion occurred. The buildings were wrecked, and his father was instantly killed. The boiler was not insured, and as far as he could estimate the damage, he thought it would be about £150. His brother and another man were also injured. The only fault his father ever found with the boiler was that it was too small. On casting days they had to stop about half-time, as the boiler would not hold steam enough for the blast, and it took some time for the steam to be raised again when once it got down.

Joseph Geddes said he had been four years in the service of the firm as apprentice fitter. The boiler was usually worked at a pressure of from 20 to 30 pounds, but on casting days it was put up to 85 pounds before the blast was started. The ball on the safety valve lever was of no use, as it would not allow the steam to rise to more than 20 pounds, so they had to add extra weights, pinion wheels being generally used for the purpose. The finger of the pressure gauge would not go further than 85 pounds, and the gauge was generally watched to see that the pressure did not rise beyond that point. A short time before the explosion he saw that the valve was blowing off at 60 pounds; there were then two pinions in addition to the ball on the lever. When he saw the steam blowing off he informed Mr. Adam, who then told him to add a piece of cast iron to the lever, and witness did so, putting it on to the extreme end. The blowing then stopped, and the pressure rose to between 70 and 80 pounds. This was about four minutes before the explosion, and Mr. Adam, who was then standing in front of the boiler looking at the gauge, gave the order for the engine to be started, making a remark at the time to the effect that "there was never any fear of a boiler when the steam was on." The explosion occurred immediately after, and witness was somewhat badly hurt thereby.

David Adam, iron molder, said that the boiler was attended by Geddes and his father. Just before the explosion he noticed his father looking at the pressure gauge. Witness did not know what had happened until he was subsequently picked up outside the works. He was somewhat injured, and had been laid up several days.

John Young, blacksmith, deposed to having put a patch on the back end of the boiler. After the explosion he found Mr. Adam some 12 feet from the boiler, which had been torn from its seat and the pieces scattered in various directions. The dome was carried some distance down to the beach, and the other portions were found in different places.

Mr. William Adam, recalled by the president, stated that when they were applying the patch he did not notice the thickness of the plates.

Andrew Jolly said he was a currier by trade, and some time ago his effects were sold by public auction at Glasgow. Among them was an old Cornish boiler which he had not used for several years. It was described in the catalogue of sale as "Lot 81, old boiler." It stood outside for a long time, and he never used it for driving an engine. Witness was shown an entry in the list of sales, "Moore, £2 5s.," but said he did not know who purchased the boiler at the time. The boiler was second-hand when he bought it 12 or 14 years ago. He practically never worked it at any pressure, as, when he had it in use, it was simply for heating the liquor for currying leather. Steam never reached more than 5 pounds. When his effects were sold the boiler had been for some years out of use. He thought he might have given £8 or £10 for it originally, and, as far as he recollected, it had previously been fixed on board a steam yacht. He never made any test of the boiler, nor any repairs.

Mr. James Barnet, engineer surveyor at Aberdeen for the Board of Trade, said he had made an examination of the exploded boiler, and found that the external shell was torn into four large pieces, with one or two smaller pieces. The boiler was of the single-flued class, and measured only 4 feet 1 inch in length by about 3 feet in diameter. He described minutely the general construction of the boiler, with its equipment of fittings, and, with regard to the explosion, stated that the shell ruptured longitudinally and fractured in a line through the manhole along the top, and by the side of the steam dome, while the front end plate was blown completely off. With regard to the cause of the rupture witness said there were indications of corrosion in the form of grooving near the water level, while nuts had been put into the external shell to fill up wasted holes. The pressure on the boiler, he calculated, was 75 pounds on the square inch.

By the Commissioners: Simply applying hydraulic pressure was not a safe guide whereby to ascertain the safe working point of a boiler. The grooving was extensive, and ran along the whole length of the boiler. The plates were very much reduced, and at one place there was practically no thickness at all remaining. The upper parts of the end-plates were unstayed, and the plates there were only one quarter inch thick originally. The explosion was caused by over-pressure, grooving, and corrosion, the boiler in reality being so much reduced that it was not suitable for any useful pressure. If a careful inspection had been made by any skilled engineer, he must have ascertained its dangerous condition. Witness had written to Mr. John Moore, who had sold the boiler to the deceased, Mr. Adam, and received a letter in reply in which Mr. Moore regretted the death of Mr. Adam, and gave information regarding the boiler to the effect that "he did not know the age of the boiler, having bought it at a public sale from Andrew Jolly, Hamilton street, Glasgow, in August, 1892. He made no repairs to it, but it was tested to 100 pounds by hydraulic pressure. He did not tell Mr. Adam at what pressure to work it, as he did not know his requirements. Mr. Adam inspected it, and said it would suit his purpose." The hydraulic test to 100 pounds witness did not regard as any indication of the boiler being safe. He did not think the boiler could possibly have been in safe condition when Mr. Adam bought it, judging by the extent of the corrosion. There was nothing on the boiler to indicate the maker or the age.

The evidence being concluded, and the Commissioners having inspected the fragments of the boiler, Mr. Peterkin submitted the following questions to the judgment of the Court:

1. What was the cause of the explosion?
2. Had the deceased Mr. Adam the necessary technical knowledge to form an opinion as to the condition of the boiler in question, or had he taken sufficient steps through competent persons to ascertain that the boiler was fit to be employed at the time of the explosion for the work at the pressure at which it was used?
3. Was the firm of William Adam & Son justified in employing the boiler for the work, and at the pressure at which it was used when it exploded?
4. Does blame for the explosion attach to any one?

After some deliberation, the presiding Commissioner intimated that the Court had arrived at the following conclusions:

1. They were of opinion that the cause of the explosion was over-pressure, grooving, and corrosion.

2. Mr. Adam had not the necessary technical knowledge, and he did not take sufficient steps through competent persons to ascertain that the boiler was fit for use.

3. The firm were not justified in employing the boiler for the work and at the pressure indicated.

4. Blame for the explosion, in their opinion, attached to the deceased Mr. Adam.

The Court made no order as to costs, the person most to blame having been the owner, who had been killed by the explosion.

### Engineers Meet at Ball & Wood's Works.

Saturday afternoon, March 31st, a large number of engineers gathered, by special invitation, at the works of the Ball & Wood Company, at Elizabethport, N. J., the ostensible object of the visit being to see the new engine built by that company, which is to be erected at the works of the Chicago Edison Company. This engine, which is of 600 horse-power, was found on the floor of the works, under steam, and it attracted a good deal of attention. We have been requested by the company not, at this time, to attempt anything like a description of this engine, which in many respects presents novel features. We violate no confidence, however, in saying that it is a vertical compound engine, with cylinders side by side, with main valves in the cylinder heads, and cut-off valves, controlled by the governor, working inside the main rotary valves. The Corliss wrist-plate motion is employed, modified and compounded, to bring about what are believed to be better results than those usually obtained by such modifications. There is, of course, no detachable arrangement, all valve motions being positive. The effort seems to have been, all the way through, to bring around a quick cut-off from zero up to three-quarters stroke, good regulation, and the economy resulting from small clearance space. Small floor space required and high rotative possibility seem, also, to have been well considered.

There was, also, on the floor of the shop, a small horizontal tandem compound engine, under steam, which behaved very nicely indeed.

The Ball & Wood Company have a shop very finely arranged for their business. It is built on the gallery mansard principle, the main floor being covered by a traveling crane and a railroad track entering at one end, which makes the shipping of machinery a matter of great convenience.

In one of the galleries creature comforts were spread out, so that none need go away hungry or thirsty. In all respects the entertainment offered to their friends by the Ball & Wood Company was a success.

A time like this was particularly inopportune for looking at matters around the shop. But from such observations as were casually made—the component parts of engines under construction—it does not look as if the company contemplate going out of business just yet.

There are some strange features connected with the recent developments respecting the crooked work at Carnegie's armor plate mill. How it could be that blow holes in armor plates were plugged up and concealed from the inspectors, how plates selected for inspection and test could be retempered at night, and made better than the lot they were supposed to represent, and how false entries could be made regarding the length of time of heating plates, without the proprietors having any knowledge of what was going on, is somewhat mysterious. It is also very strange that there should be those about the mill more interested in cheating than its proprietors were. Furthermore, it seems strange that a fine could be assessed for deficiencies in work acknowledged to be the best of its kind ever done, and considerably above the minimum requirements of the contract.

It is pretty safe to say that the whole truth has not yet come out regarding this matter, and it is doubtful if it ever will come out.

A London dispatch under date of March 29th says: Mr. William Mather, Member of Parliament for the Gorton division of Lancashire, and the senior member of the firm of Mather & Pratt (Salford Iron Works), has made a report of the experience of his firm in the first year's experiment of giving his employes an eight-hour day, instead of nine hours, without any reduction of wages.

Mr. Mather, whose works employ a large number of hands, reports that the experiment has proved in every respect a complete success. The output of the works has been greater than ever before, without an increase of expense, despite the reduction of hours.

Mr. Hans Renold, of Manchester, England, who is a very large manufacturer of bicycle and other chains for transmission, and who uses in his factory a good deal of American machinery, is now here looking into the matter of further purchases from our tool builders, and may incidentally make arrangements whereby he can do something to maintain the "balance of trade" by sending some of his bicycle chains here. A specimen of one of these—the roller chain, illustrated in Fig. 1, our issue of October 26, 1893, is far the best and most beautiful bicycle chain we ever saw.

## MANUFACTURES.

The Clifton Iron Co., of Ironaton, Ala., has blown in one of its stacks.

Central furnace of the Cleveland (O.) Rolling-mill Co. has been put in blast.

The Illinois Steel Co. has started up another of its blast furnaces, at South Chicago.

The Helmbacher Forge and Rolling-mill Co., Pittsburgh, Pa., has started up two scrap furnaces.

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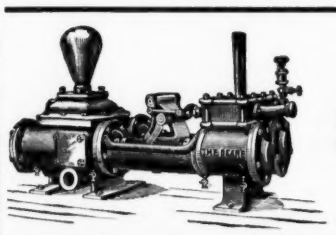

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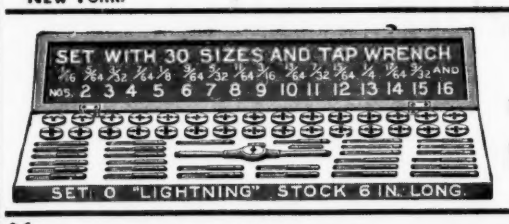


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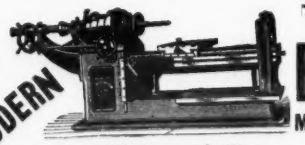
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The Hall & Brown Woodworking Machine Co., Pittsburgh, Pa., are now making nine hours a day and will soon resume on ten hours with a full force of men.

D. Saunders Sons, Yonkers, N. Y., inform us that while there is no boom in their business it is slowly and steadily brightening in a way to give them encouragement.

At Donaldsonville, La., arrangements have been made for the erection of a foundry and a machine shop. The Donaldsonville Land and Improvement Co. have the matter in hand.

The reorganization of the old Southern Iron Co. into the Central Iron Co., Nashville, Tenn., has now been effected, and the company's furnaces and other properties will be operated.

The Rand Drill Co., 23 Park Place, New York, manufacturers of rock drills, air compressors, etc., informed us on March 28th last that their trade shows a steadily improving tendency.

James Oates and W. Moffatt, at Charlotte, N. C., are forming a company for the purpose of erecting works for the manufacture of pumps and heaters. The capital stock is to be $25,000.

Abendroth & Root Mfg. Co., 28 Cliff street, New York, manufacturers of the Root water tube boiler, are running their works full handed and full time, with prospects of having to work overtime.

The Colorado Fuel and Iron Co., of Pueblo, Col., states that the wage question has been settled at its works, and that the plant is now in operation. One furnace is now in blast, and it expects to start the rail-mill.

The Lodge & Davis Machine Tool Co., of Cincinnati, O., write us: We have just received a large order from the Butte, Anaconda & Pacific Railway Co. for a complete outfit of tools to be used in their shops at Anaconda, Montana.

The Keystone Mfg. Co., of Buffalo, N. Y., have issued a new catalogue describing their improved ratchet wrenches, ratchet drills, etc. The catalogue is fully illustrated and contains matter of interest to those who are users of such tools.

The Oliver & Roberts Wire Company, Pittsburgh, Pa., is running its plant to full capacity, employing over 150 more men than it had this time last year. The company is now erecting a shop which will greatly increase the output and give work to an additional number of men.

The Phœnix Iron Co., of Phœnixville, Pa., has secured the contract to erect an iron pier at Long Branch, N. J.; also the contract for several thousand tons of elevated railroad material to go to Brooklyn, N. Y. This contract calls for the entire equipment of stations, platforms, waiting rooms, etc.

The Minneapolis (Minn.) Rolling-mill Co. has been reorganized by E. S. Baring-Gould, A. Z. Levering, W. A. Koon and others, with the capital stock placed at $500,000. The machinery, which has been ready for use for almost a year, will be put in position about the middle of April, and it is thought that the plant can be operated by June 1st.

A contract for building and equipping about one hundred miles of electric road for the Nassau Electric Railroad Company, in Brooklyn, at a cost of about $12,000,000, has been signed in Boston. The work will be done by the Johnston Rail Company, of Johnstown, Pa., and the equipment supplied by the Thomson-Houston and Westinghouse Electric Companies.

As a result of the refusal of the management to restore a recent 25 per cent. reduction in wages, the molders employed by the Lockwood Manufacturing Company, South Norwalk, Conn., have struck. The company refused to grant the demands of the men for an increase, announcing that a six-months' shut-down would be preferable, and the men did not return to work.

It may not be generally known that the United States is the owner of a rolling-mill at Charlestown, Mass., and of another at Rock Island, Ill. The rolling-mill at the Charlestown Navy Yard has recently resumed operations. Orders have been received to have the iron for chain-making rolled at this yard. The cable for the three new warships, "Oregon," "Massachusetts" and "Indiana," will be made there.—*Labor Tribune.*

The Detrick & Harvey Machine Co., of Baltimore, have recently purchased from the Capitol Mfg. Co., of Chicago, their business of manufacturing the well-known Adams bolt-threading and Cook nut-tapping machines. The first-mentioned firm state that with their facilities for manufacturing they will endeavor and think they will have no difficulty in maintaining the excellent reputation which these machines have attained.

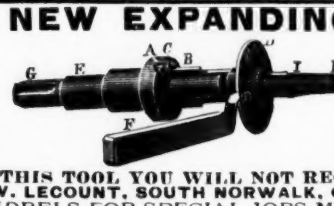
An Auburn (N. Y.) dispatch says: There are evidences of the revival of trade in this city. A solid train of fifty cars, drawn by two locomotives and loaded with farm machinery, left here this afternoon bound for the New England States. Three weeks ago a similar train of thirty one loaded cars went East. It was the first solid train loaded with farm implements which ever entered New England. The train to-day was the second instalment and more are to follow. This city, which has suffered depression, is thus encouraged, for every implement of whatever nature on the two trains had been sold before it left this city. Shops are in operation with a full force of men, and indications point to prosperity.

On the 21st of March a new company with $100,000 capital, and to be called the Specialty Manufacturing Co., was organized in Hartford, Conn. The following gentlemen compose the directorate: Mr. George J. Capewell, president (vice-president Capewell Horse Nail Co.); Austin Brainard, vice-president (director Ætna Machine Co.); Charles Flint, secretary and treasurer; E. C. Lewis (president Waterbury Farrel Foundry); John H. Hall (general manager Colt's Patent Firearms Co.); A. W. C. Williams (general manager Capewell Horse Nail Co.); J. H. Knight (president First National Bank, Hartford). The company will engage in the manufacture and sale of patented "specialties" commencing with a number of patents of Mr. George J. Capewell, in the line of nail and tack pullers, barrel-nail pullers, cutting nippers, etc.

A Chicago dispatch of March 20th says: A local paper to-day says that arrangements for a combination of sewing-machine manufacturers, with assets of more than $5,000,000, are in progress here. The combination will, it is said, absorb the business of the White Sewing Machine Company, of Cleveland; the Standard Sewing Machine Company, of Cleveland; the Davis Sewing Machine Company, of Dayton, O., and the Domestic Sewing Machine Company, of Newark, N. J. The last-named company is now in the hands of a receiver, and this fact has delayed matters materially. The Domestic manufacturing plant, it is said, will be removed from Newark, and combined with the


**LECOUNT'S NEW EXPANDING MANDREL.**

**Amateur's Size.**
Taking anything from ⅛ to 1 inch inclusive.
Price.....$5.00
Patented Dec. 25, 1877.




**Machinist's Size.**

| No. | | Price. |
|---|---|---|
| 1 | ⅛ to 1 in. | $10 |
| 2 | 1 " 1½ " | 14 |
| 3 | 1½ " 2 " | 18 |
| 4 (with screws) | 2 " 3 " | 32 |
| 5 " " | 3 " 4 " | 44 |

IF YOU WILL TRY THIS TOOL YOU WILL NOT REGRET THE EXPENSE.
C. W. LECOUNT, SOUTH NORWALK, CONN.
SPECIAL MANDRELS FOR SPECIAL JOBS MADE TO ORDER.
These goods are for sale by CHAS. CHURCHILL & CO., L't'd. 21 Cross St., London, England.

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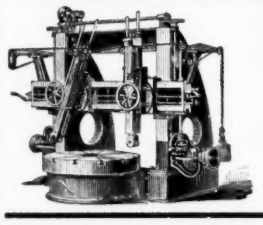
INSIST ON HAVING
NICHOLSON.

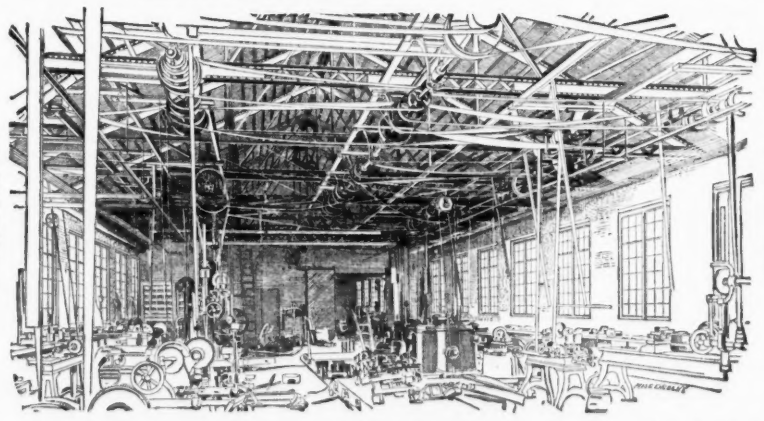
**NICHOLSON FILE CO.**
PROVIDENCE, R. I., U. S. A.
3000
VARIETIES FILES
[X. F.] & INCREMENT CUT FILES.



**BORING AND TURNING MILLS**
COMBINING EVERY IMPROVEMENT.
14 SIZES FROM 5 TO 20 FEET.
**BETTS MACHINE COMPANY,**
WILMINGTON, DEL.

**THE BERLIN IRON BRIDGE CO.**
Office and Works,
**No. 8 Railroad Ave., East Berlin, Conn.**
CHAS. M. JARVIS, Pres. and Chief Engineer. BURR K. FIELD, Vice-President.
FRANK L. WILCOX, Treasurer. GEO. H. SAGE, Secretary

Engineers, Architects and Builders of



Iron and Steel Bridges and Buildings.

The above illustration is taken direct from a photograph, and shows the construction of an Iron Truss Roof designed and built by us for The C. W. Hunt Co., at West New Brighton, Staten Island, New York. The building is 42 feet in width by 202 feet in length, and is used by the C.W. Hunt Co. as a Machine Shop. The side walls are of brick and the roof trusses of iron, with iron purlins covered with slate, so that no wood work is used about the construction of the building in any way, shape or manner, thus eliminating entirely the danger from fire. This is one of the best designed and equipped Machine Shops of its size in the United States.

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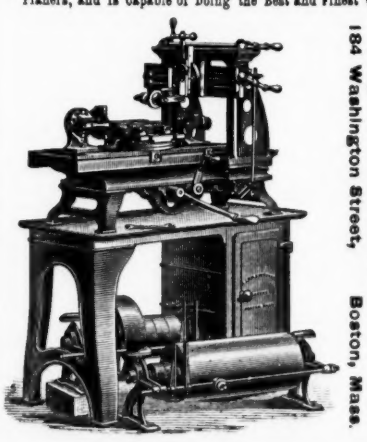
**POWER OR HAND PLANER,**
FOR MODEL MAKERS, EXPERIMENTAL WORK, &c.
Has all the Improved Features Usually Found on High Grade Planers, and is Capable of Doing the Best and Finest Work.



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A. J. WILKINSON & CO.,
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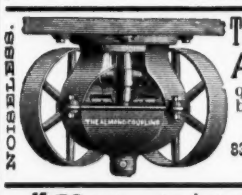
SECTION



**The Almond Coupling**
A NEW quarter turn motion to replace quarter turn belts and bevel gears.
T. R. ALMOND, MFR.,
83 and 85 Washington Street,
BROOKLYN, N. Y.

"Star" Foot Lathe Swings 9x25 in.
LA THE
Screw Cutting Automatic Cross Feed, etc.
Scroll Saws, Circular Saws, Lathes Mortisers.
HE
Catalogue Free of all our Machinery.
Seneca Falls Mfg. Co. 687 Water St., Seneca Falls, N.Y.

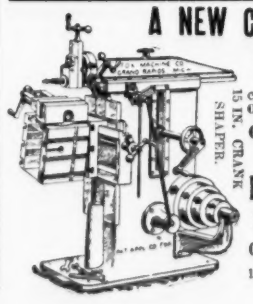
**BUILDERS IRON FOUNDRY,**
FOUNDERS AND MACHINISTS.
PROVIDENCE, R. I.

**Globe Special Castings for Water Works, Mills and Railroads.**
The general form is that of a sphere or globe with bells attached. This offers the greatest resistance to bursting strains and renders the castings comparatively light and compact. It also makes possible the advantageous combination of a number of branches in a single casting.

**LATHES, PLANERS, DRILLS,**
AND OTHER
IRON WORKING TOOLS.
Before ordering send us a memorandum of your requirements.
**COOKE & CO.,**
163 & 165 Washington St., NEW YORK.

**FACTORIES TO LET.**
At Orangeburgh, New York, 21 miles from New York City, on the West Shore, Ontario and Western and Erie Railroads, with switch from each road. Two new one-story brick buildings, 75 x 130 feet, built on the most approved modern plans. Will be let with electric power, either singly or together. This location is unsurpassed for manufacturing purposes. For further information apply to T. T. P. LUQUER, Agent, 45 Broadway, New York.

**A NEW CRANK SHAPER.**
NOVEL, YET SIMPLE.




Length of stroke changed INSTANTANEOUSLY while IN MOTION.
Get Photos & Prices.
NOTHING LIKE IT.
**Fox Machine Co.,**
325 Nor. Front St.,
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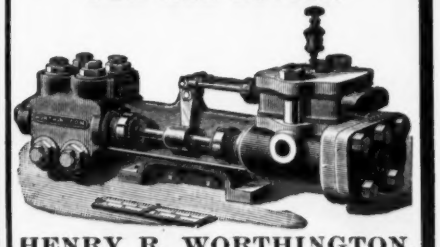
135 Finsbury Pavement, London, England.

**P.H.&F.M.ROOTS,**
Connersville, Indiana.
Chicago Office, 501 Manhattan Building.
MANUFACTURERS OF
PORTABLE FORGES, TUYERE IRONS, ETC.

**ROOTS' NEW ACME HAND BLOWERS**
Slow speeded, Force-blast, Durable, Compact and Cheap.
Roots' Foundry Blowers, Gas Exhausters, etc.
S. S. TOWNSEND, Gen. Agt. COOKE & CO., Selling Agts. } 163 & 165 WASHINGTON ST., NEW YORK.
*In Writing, Please Mention This Paper.*

**WORTHINGTON STEAM PUMPS**
FOR ALL DUTIES.



HENRY R. WORTHINGTON,
NEW YORK,
BOSTON, PHILADELPHIA, CHICAGO,
ST. LOUIS, DENVER.

Davis plant at Dayton, O. The two Cleveland plants of the White and Standard Companies will be removed to Chicago. As contemplated, George P. Hoffman, of Dayton, O., will be president, and a Cleveland man, Thomas B White, will probably be selected as vice-president. In the directory will be J. E French and A. L. Moore, of Cleveland; L A. Johnson and E. J. Barney, of Dayton, and the vice-president of the New York Guaranty and Indemnity Company.

### Machinists' Supplies and Iron.

New York, March 31, 1894.

Iron—American Pig—We quote Standard Northern brands, No. 1 Foundry, $12.75 to $13.50; No. 2, $12.00 to $12.50; Gray Forge, $11.25 to $12.00. Southern brands of good quality are obtainable at $12 25 to $13.00 for No. 1 Foundry; $11.00 to $11.50 for No. 2, and $10.75 to $11.25 for Gray Forge.

Antimony—The market is steady and quiet. We quote L X., 9¼c. to 9⅝c.; Cookson's, 10c. to 10⅛c.; Hallett's, 8¾c. to 9c., and U. S. French Star, 10c.

Lard Oil—Prime is quoted at 62c. to 63½c.

Copper—The market is dull and the demand is light, as buyers expect lower prices in the near future. Lake Copper is offered at 9.50c. to 9.60c. Casting Copper is held at 9.10c. to 9¼c.

Lead—The market is unsettled. Bids of 3.45c. are solicited without resulting in business.

Spelter—The market is dull. Quotations are nominal at 3.80c. to 3.85c. for New York delivery. The buyer's wants are limited.

Tin—The market is weak with offerings at 19.30c. for prompt delivery, and less would be accepted for futures. Speculative interests are absent and the jobbing demand is light.

## WANTED

*"Situation and Help" Advertisements only inserted under this head. Rate 30 cents a line for each insertion. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.*

Wanted—Position as foreman of boiler shop: A No. 1 refs. Boilermaker, 20 Olive St., Lowell, Mass.

Foreman patternmaker, desirous of making a change, well up in bridge, roofing and architectural work. Address 435, American Machinist.

Wanted—Position by a draftsman, experienced in coal mining, rolling-mill, steel work and general machinery. Box 44, American Machinist.

Position wanted by all-around machinist and tool maker; 7 years' experience as foreman; best of reference. Box 45, American Machinist.

A position where a simple but thorough system of keeping cost and time accounts could be made of use. Box 47, American Machinist.

Tool maker experienced on all kinds of labor-saving tools, tool-room work, etc.; references if required. Address Box 48, American Machinist.

Draftsman with 2 years' exp., tech. education, and who has served his time in machine shop, wants position; age 24. Box 49, American Machinist.

Mechanical draftsman, college educated, with practical exp. in eng. gen'l and experim l work; open to engagem't after April 14. Box 50, Am. Mach.

Wanted—Position as foreman in iron foundry, one familiar with all kinds of light and heavy castings in green, dry sand, and loam; references from last employer. P. H. Fox, Am. Machinist.

Wanted—A first class spring maker, one who knows how to make coil and flat ribbon springs; also thor. understands tempering and drawing; state experience, and give reference from where last employed. "D. R.," American Machinist.

Wanted—Situation by experienced mechanic with theoretic education, designer of special tools and well acquainted with interchangeable system; held positions as foreman, head draftsman and assistant superintendent. A. B., Amer. Machinist.

Wanted—Mechanic to take charge of pattern and machine shop and foundry; one who understands drafting and is capable of making estimates. Address, stating experience, where formerly employed, reasons for leaving and references, age and salary expected for start, P. M. F., American Machinist.

Works manager or otherwise—Mechanical engineer of university (London) education, and long & varied experience in designing, estimating, economical production & handling of men, desires pos. on salary or profit-sharing; can introd'e good spec's to a mfr.; office bus. not obj'd to. Box 51, Am. Mach.

## ✢ MISCELLANEOUS WANTS ✢

*Advertisements will be inserted under this head at 35 cents per line, each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.*

Cheap 2d hd lathes & planers. S.M.York, Clev'd, O.

Best Steel Flue Scrapers. Kelley Co., Erie, Pa.

For Sale—Second-hand drill presses, engine lathes & planers. Dietz, Schumacher & Co., Cincinnati, O.

Light and fine machinery to order; Foot Lathe Catalogue for stamp. E. O. Chase, Newark, N. J.

Calipers, Surface Gauges, etc. Catalogue free. Send for it. F A. Welles, Milwaukee, Wis.

Introduction and negotiation of American patents and machinery to English manufacturers and agents. Write for circular to Geo. Richards, M I. M E., Mechanical and Consulting Engineer, No. 5 Laurence Pountney Hill, London, England.

Locomotive "999." Do you want a picture of her? Send 50 cents for our fine copper plate *transparent* picture (14x28), showing all parts *inside* and *outside*, all named and numbered, on satin gloss paper, for framing, educational, beautiful, correct. Locomotive Engineering, 912 Temple Court, New York.

Michigan Agricultural College offers instruction in mechanical engineering—four years' course; the average expense of attendance at the college is $135 per year; the course is arranged so as to give students an opportunity to earn a portion of their expenses. Address Mechanical Department, Agricultural College P. O., Mich.

Established in 1874.

CLEVELAND TWIST DRILL CO.

COR. LAKE & KIRTLAND STS., CLEVELAND, O.

100 & 102 Reade Street, New York.
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Second-Hand Machinery

MODERN STYLE, IN GOOD ORDER
BEING THE EQUIPMENT OF A
MACHINE TOOL SHOP
AND AN
ENGINE AND BOILER WORKS.

IRON PLANERS, 16 in. x 4 ft., 19 in. x 3 ft., 20 in. x 4 ft.
22 in. x 6 ft., 24 in. x 4, 5 and 6 ft.
26 in. x 6 and 8 ft., 30 in x 6 and 10 ft.
32 in. x 6 ft., 36 in. x 8, 10 and 16 ft.
ENGINE LATHES, 13 in. x 6 ft. 16 in. x 6 and 8 ft., 18 in. x 8 ft.
20 in x 10 and 12 ft., 24 in. x 10, 12 and 16 ft., 30 in. x 10 ft., 32 in. x 16 ft., 52 in. x 24 ft., 84 in x 18 ft.
PIT LATHE, to turn up to 16 ft. wheels.
SHAPERS, 6, 8, 9, 12, 15, and 16 in.
UPRIGHT DRILLS, 20, 24, 48 and 68 in.
RADIAL DRILLS, 3 and 4 ft. arms.
MILLING MACHINES, "Cinti" No. 2, also "Ingersoll," extra heavy Table 22 in. x 4 ft.
GEAR CUTTER, cuts 36 in. Spur and Bevels, "Gould's."
KEYSEATING MACHINE for Pulleys and Wheels.
UPRIGHT BORING AND TURNING MILL, 38 in. with two heads.
UPRIGHT TURRET CHUCKING MILL, Brown & Sharpe's.
STEAM HAMMER, 300 lbs., "Ferris and Miles."
BOILER BENDING ROLLS, 6, 8 and 10 feet.
BOILER PUNCH AND SHEAR, 36 in. gap; 1 in. through, 1 in. iron, weight 14,000 lbs. "Improved style."
BOILER FLANGE CLAMPS, 6 and 10 ft.
BRIDGE RIVETING MACHINE, "Allen's Pneumatic."

J. J. McCABE,
SUCCESSOR TO
E. P. BULLARD'S
N. Y. Mach'y Warerooms.
14 Dey St.,
NEW YORK.

MACHINERY
NEW AND SECOND-HAND.

Plate Planer, 16½ ft., one setting. 1 in. Plate.
Shear No. 27, 30 in. throat, ¾ in. plate.
Above entirely New, made by Bement, Miles & Co.
Boiler Rolls, 8 ft. 3 in. between Housing. Cheap.
Punch, 21 in. throat. Teal.
57 in. Swing Driving Wheel Lathe, Double Head.

ENGINE LATHES.

| | | |
|---|---|---|
| 100 inches | x 20 | feet. |
| 74 " | 24 | " |
| 51 " | 18 | " |
| 48 " | 16 | " |
| 40 " | 14 | " |
| 25 " | 24 and 16 | feet. |
| 24 " | 25 | feet. |

Other Sizes.
Profiling Machine, P. & W.
No. 1 & 3 Universal Miller, B. & S.
1,500 Steam Hammer, Morgan.
200 Bradley " Upright.
Lot of Polishing Machines.
Shafting, Belting.

PLANERS.

| | | |
|---|---|---|
| 72 inches x 25 feet. | 4 | Heads. |
| 69 " 15 " | 1 | " |
| 60 " 20 " | 2 | " |
| 42 " 12 " | 1 | " |
| 36 " 16 " | 2 | " |
| 30 inches x 12 feet. | 1 | Head. |
| 30 " 8 " | 1 | " |

Smaller Sizes Planers.
9, 12, 14, 24 and 26 in. Shaper.
8, 12, 18 in. Slotter.
Drills, Radial and Post.
Screw Machines No. 1, 2, 3, P. & W.
Dynamo for Electro-plating, etc.

SEND FOR OUR LATEST LIST.

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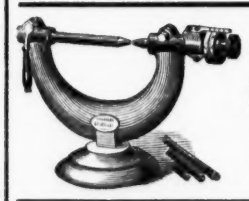
Warehouse: 511 and 513 WEST 13th STREET.
Office: 120 BROADWAY, NEW YORK.



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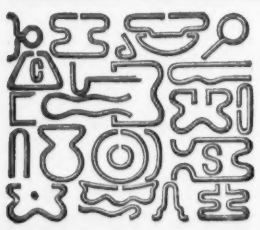
Measuring Machine.
The only micrometer that will not lose its accuracy by wear.
Satisfaction Guaranteed,
SYRACUSE
TWIST DRILL CO.,
Syracuse, N. Y.

POWER PRESSES
For Punching, Drawing, and Stamping Sheet Metal Goods of Every Description.
Taper Rolling Machines a Specialty.
The Coulter & McKenzie Mach. Co.
540 Water St., Bridgeport, Conn.

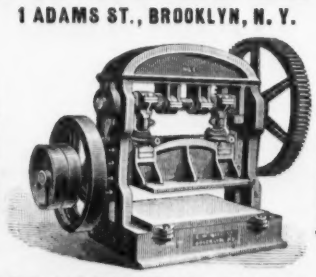
Burnham's Sensitive Drill.

SEND FOR CIRCULAR.
THE GEO. BURNHAM CO., Worcester, Mass.

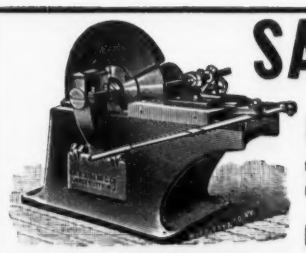


BLAKE & JOHNSON,
WATERBURY, CONN.
Builders of WIRE FORMING MACHINES
With F. B. Manville's Patent Sliding Former,
For making articles from the coil, of either round, half round, flat, or square wire, similar in shape to those shown in the cut herewith. Also similar articles made to order.
Send samples of articles required, and mention quantity wanted, that we may quote prices for either machine or the goods, whichever may be desired.
Bicycle and Labor Saving Machinery a Specialty.

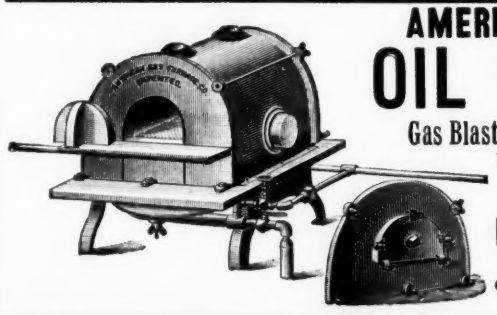
E. W. BLISS CO.,
1 ADAMS ST., BROOKLYN, N. Y.



PRESSES, PUNCHES,
DROP HAMMERS, SHEARS,
DIES AND SPECIAL MACHINERY,
The STILES & PARKER PRESS CO.



SAW FOR Cutting Hot Iron or Steel.
A. R. KING MFG. CO.,
ERIE, 11th & 12th Sts.,
JERSEY CITY, N. J.
MACHINERY AND TOOLS.
Heavy Machine Castings.



AMERICAN GAS FURNACE CO.,
OIL GAS PLANTS
Gas Blast Furnaces & High Pressure Blowers
For the economical generation and systematic application of HEAT.
CATALOGUES ON APPLICATION.
No. 80 Nassau St., - NEW YORK.
English Agency:
Chas. Churchill & Co., Ltd., 21 Cross Street, Finsbury, London, E. C., England.

GRAHAM TWIST DRILL AND CHUCK CO., DETROIT, MICH., U. S. A.
SOLE MANUFACTURERS OF
GRAHAM'S GROOVED SHANK TWIST DRILLS AND CHUCKS.

Endorsed by Practical Mechanics Everywhere. Send for Catalogue.

SECOND-HAND MACHINE TOOLS.

ENGINE LATHES.
1 14 in. x 6 ft. Bogart.
1 15 " x 5 " Flather.
1 15 " x 6 " Blaisdell.
1 15 " x 8 " Fitchburg.
1 16 " x 7 " Bement.
2 16 " x 6 " F. E. Reed.
1 16 " x 6 " Perkins.
1 18 " x 8 " Wm. Munzer.
1 20 " x 6 " Bullard.
1 26 " x 10 " New Haven.
1 26 " x 25 " L. W. Pond.
1 34 " x 20 " Perkins.

PLANERS.
1 16 in. Lathe and Morse Crank.
1 16 " x 16 in. x 3 ft. Walter Bros.
1 22 in. x 22 in. x 4 ft. Pond.
1 28 " x 28 " x 7 " New Haven.

DRILL PRESSES.
1 10 in. Barnes Friction Disc.
3 13 " Burnham Sensitive.
2 No. 2 4 Spindle Garvin.
1 " 4 6 " "
1 3 Spindle Pratt & W.
1 24 in. Cincinnati.
1 34 " Putnam, heavy, backgeared.
1 5 ft. Niles Univ. Radial.

SHAPERS.
1 10 in. Boynton & Plummer.
3 15 " Juengst, Friction.

SHAPERS.
2 15 in Wood and Light Traverse head.
1 18 in. Putnam Traverse head.

SCREW MACHINES.
1 No. 00 Garvin, wire feed.
1 " 2 Brown & Sharpe.
1 " 3 " "
1 " 5 " "

MISCELLANEOUS.
3 16 in. x 5 ft. Gage Fox Lathe, square arbor and chasing bar.
1 Gage Valve Miller.
1 No. 1 Brown & Sharpe Surface Grinder.
1 42 in. Gould & E. Automatic Gear Cutter.
2 Garvin Automatic Gear Cutters
1 Slate Automatic Gear Cutter.
1 6 in. Bement Slotter.
1 10 in. Newton Slotter.
1 No. 2 National Bolt Cutter.
1 Pratt & W. Die Sinker.
1 5 in. Cutting-Off Machine.
1 2½ Pratt & W. Screw Machine.
1 No. 31 Cutting and Drawing Press.
1 3 in. Armstrong Power Pipe Machine.
2 Bicycle Rim Rollers.
1 No. 3 Toledo Power Press.
1 No. 0 Garvin Universal Miller.

Also, large number of other machines. Write for complete list and detailed description.

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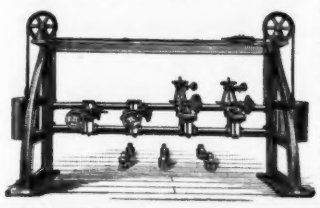

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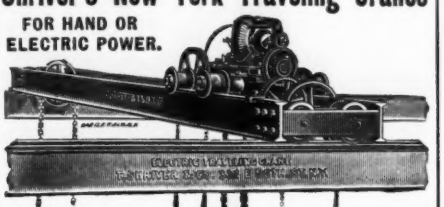

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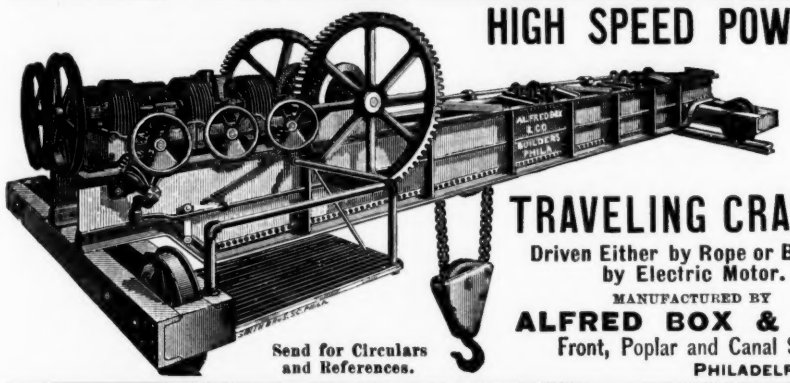

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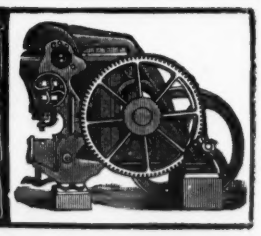

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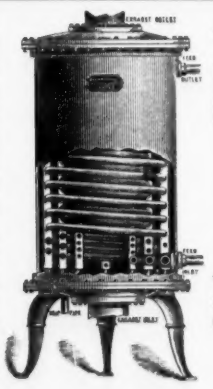

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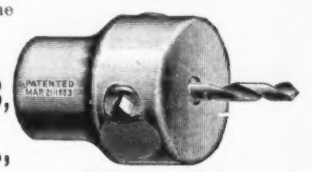

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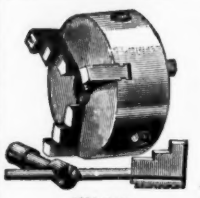

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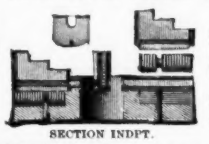

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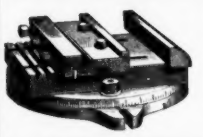

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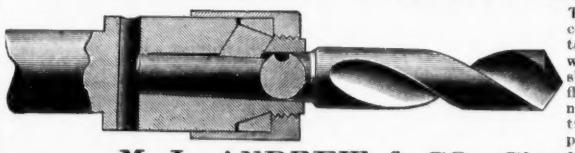

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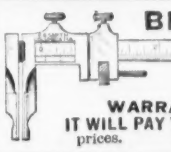

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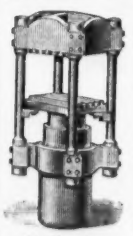

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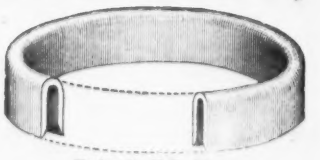

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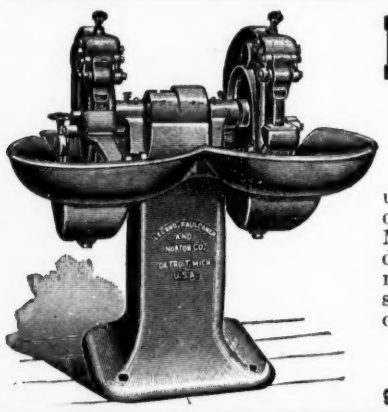

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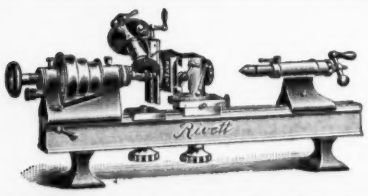


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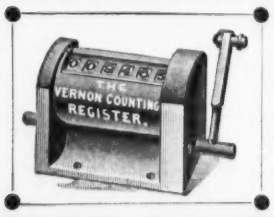


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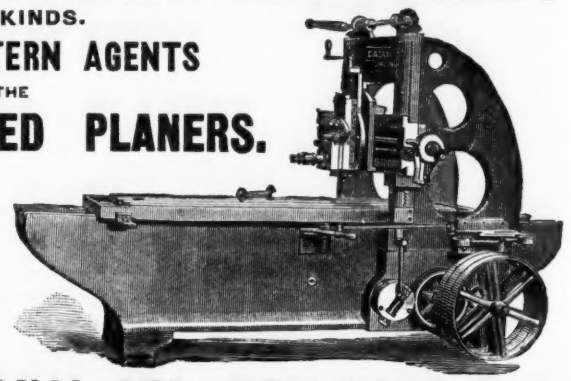

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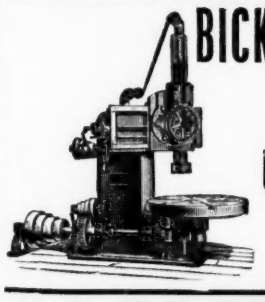

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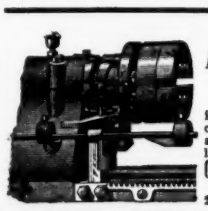

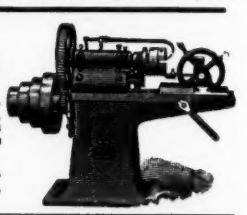

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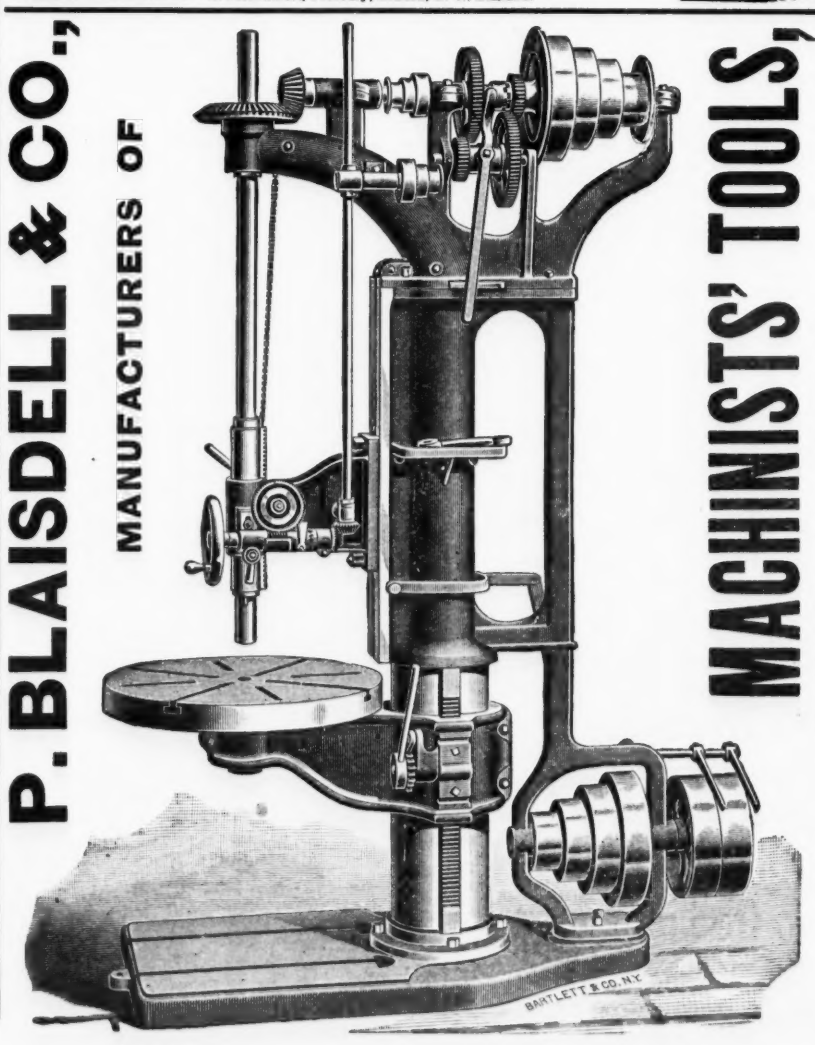

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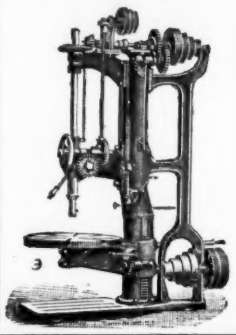

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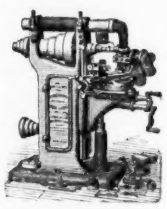

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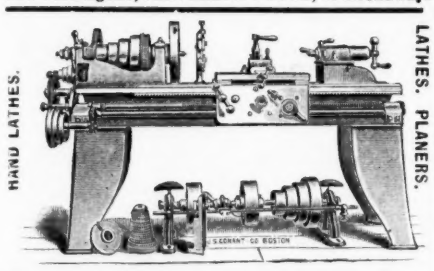


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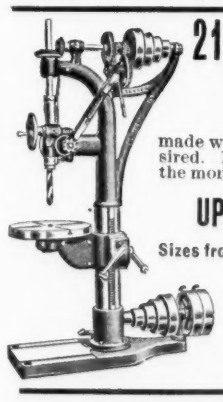

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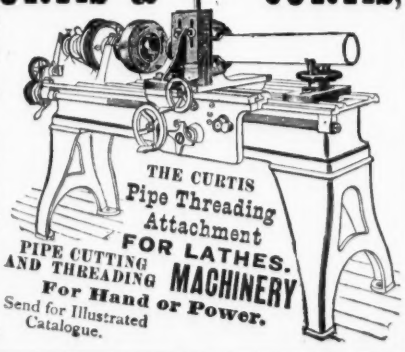


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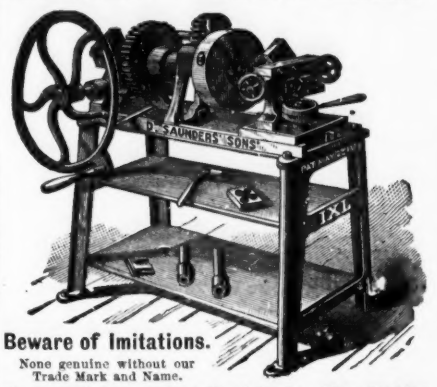


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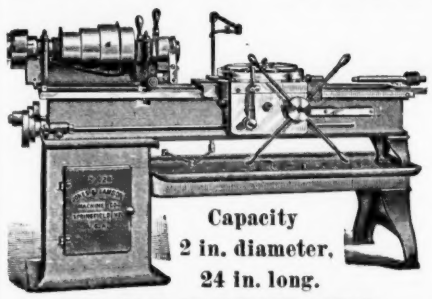

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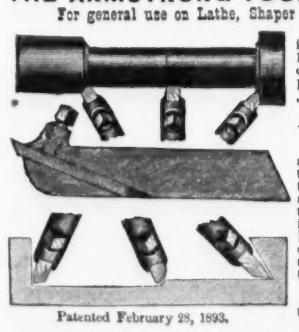

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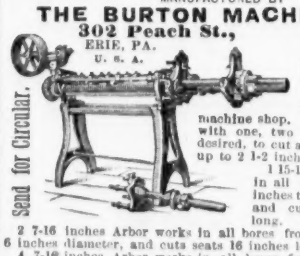

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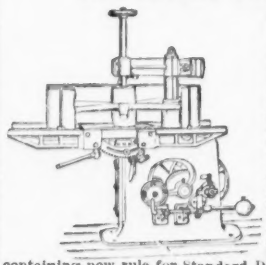

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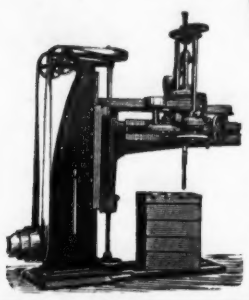

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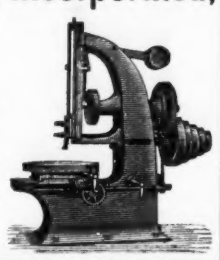

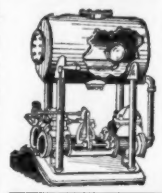

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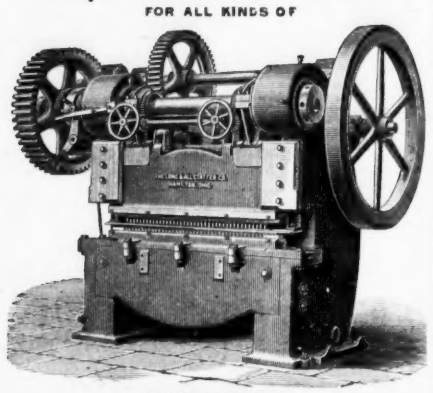

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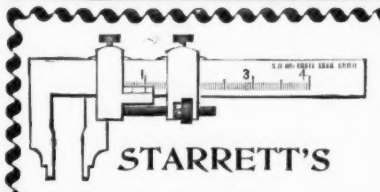

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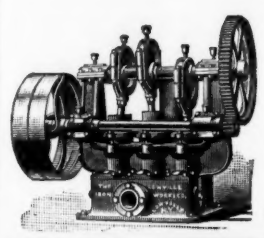

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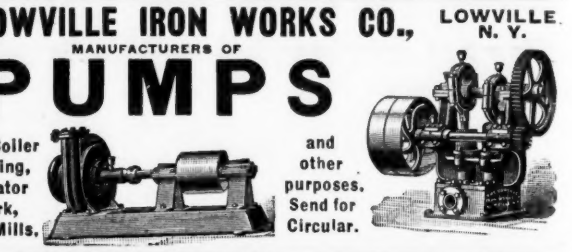

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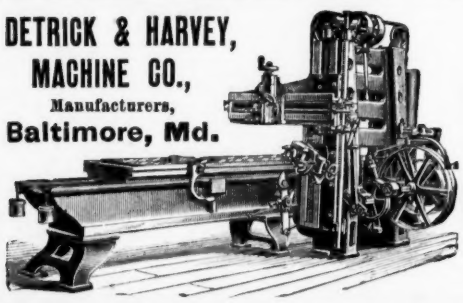

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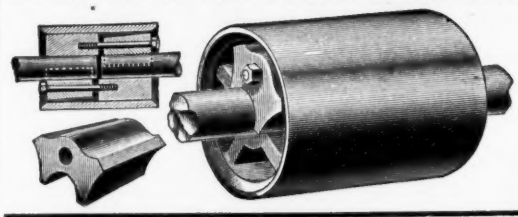

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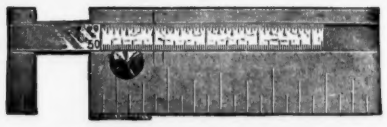

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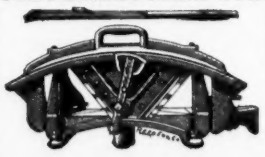

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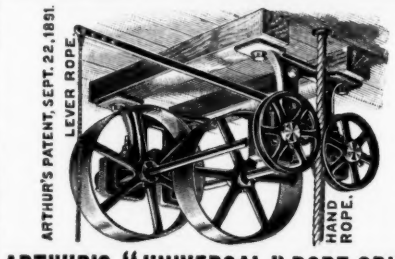


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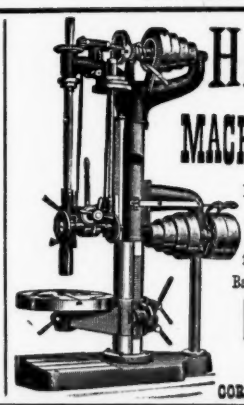

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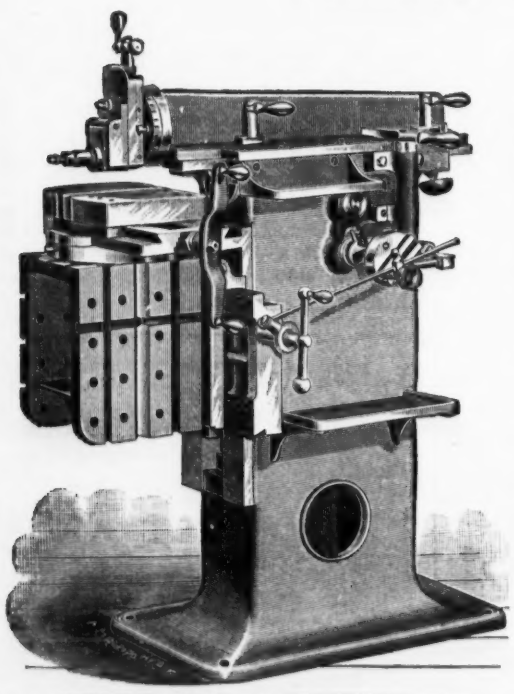

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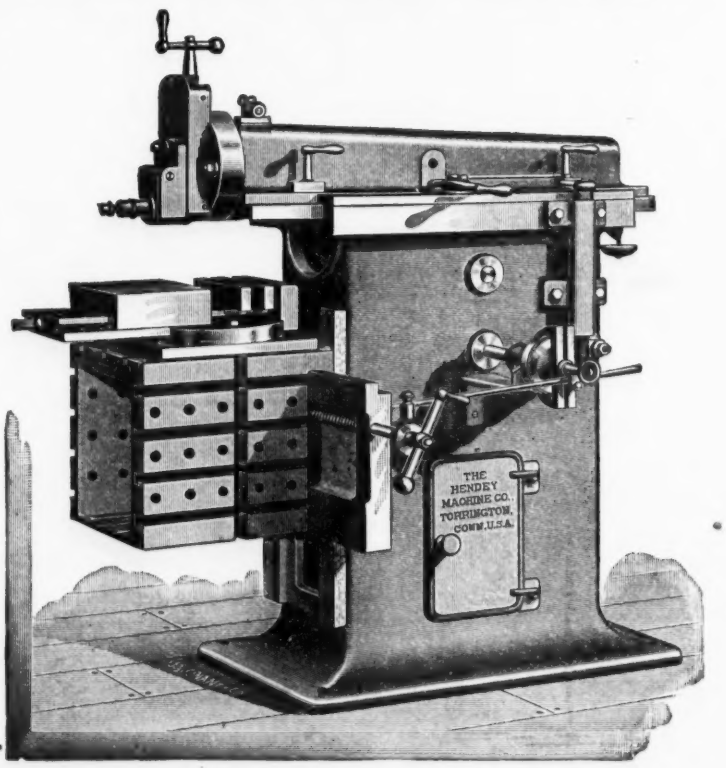


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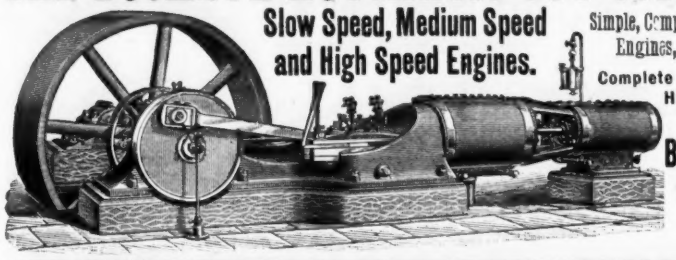

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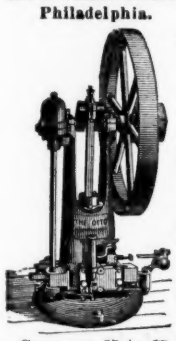

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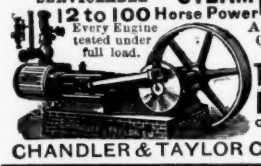

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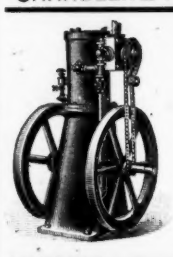

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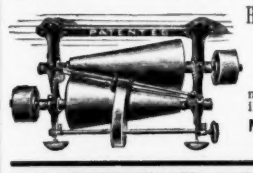

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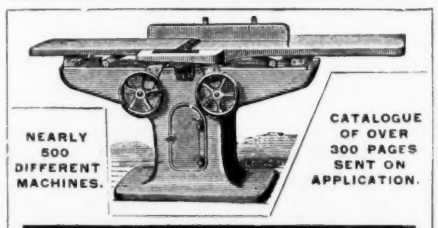


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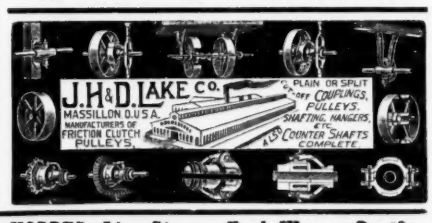


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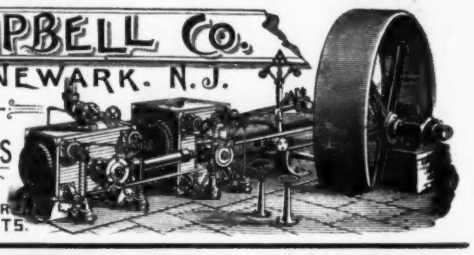

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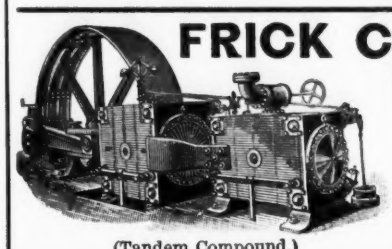

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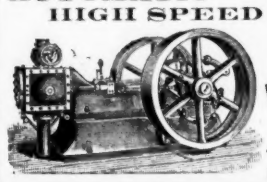

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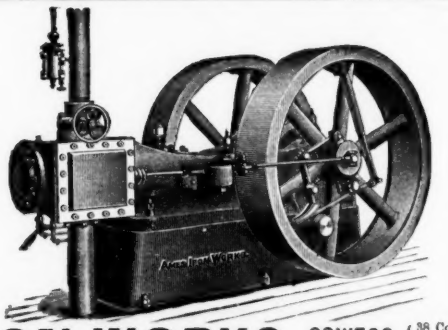

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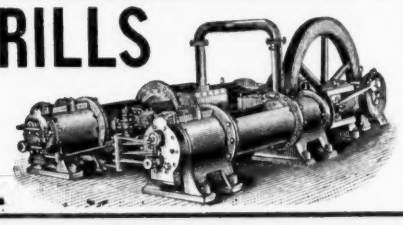

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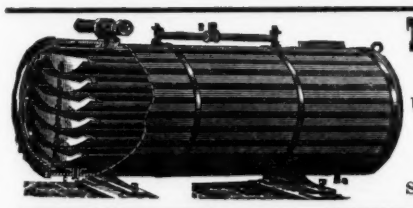

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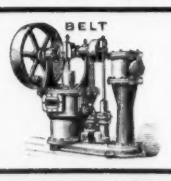


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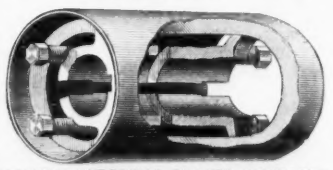

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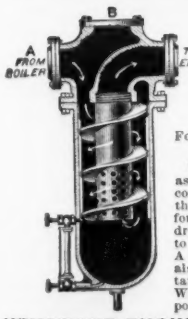


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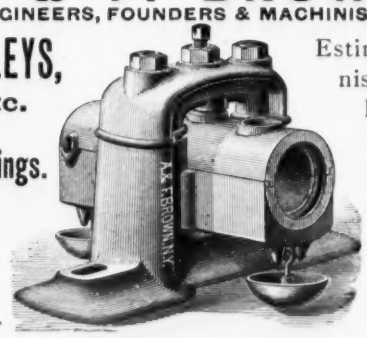


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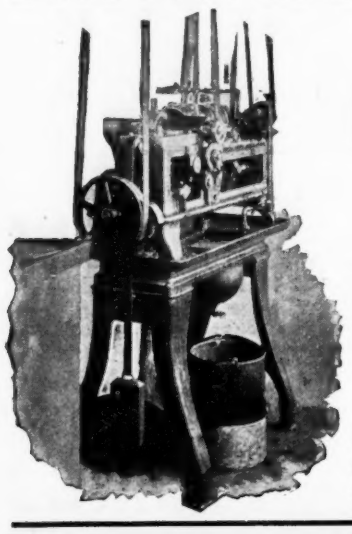

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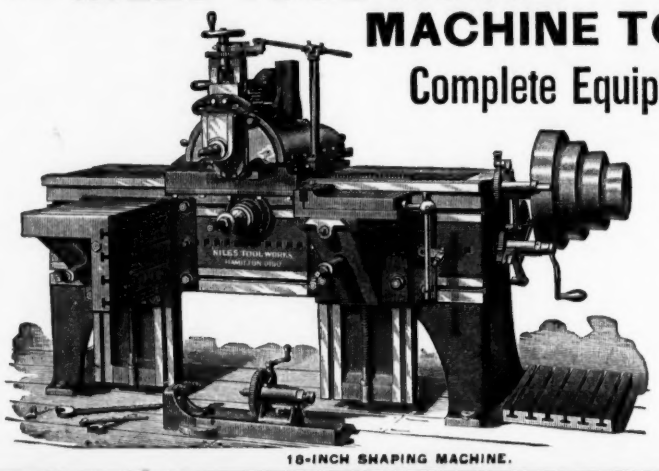

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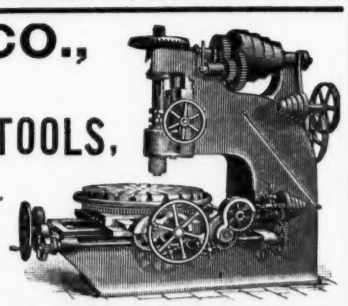

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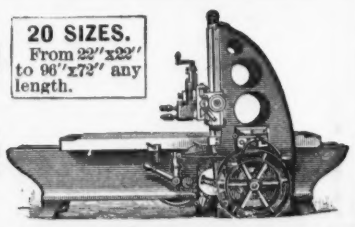

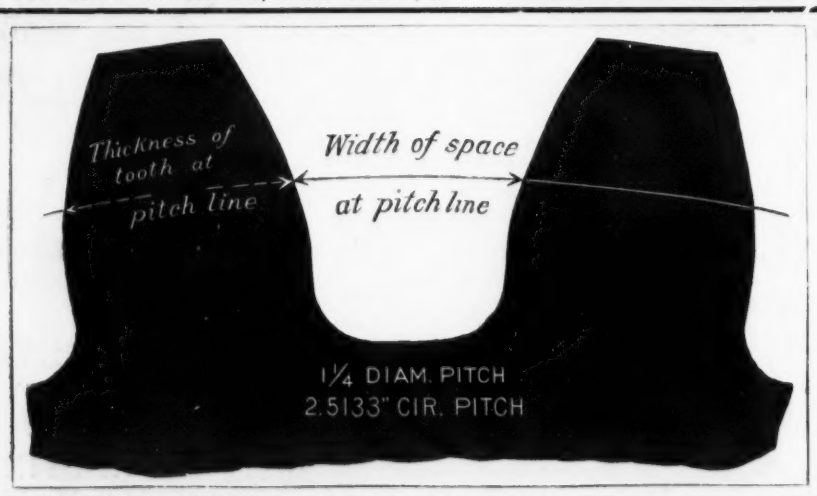


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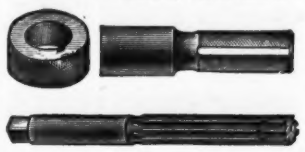

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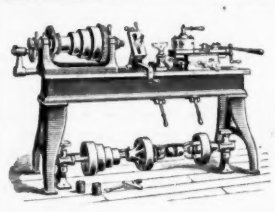

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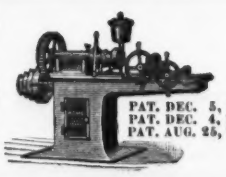

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